

Presidio of San Francisco

FOREST MANAGEMENT PLAN

1990-2010

Prepared Under the Direction of:



U. S. Army Corps of Engineers
Sacramento District
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Presidio of San Francisco
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PREFACE

This forest management plan was prepared as a long-range management tool for Army operation of the Presidio of San Francisco. The plan was developed with the cooperation and assistance of the staff of the Golden Gate National Recreation Area. A process of public review and comment on a draft plan was planned along with coordination of an environmental document before the plan was finalized and adopted.

The process of developing and adopting the forest management plan was terminated at the draft plan stage because the Base Closure and Realignment Act (Public Law 100-526 at 102 STAT 2623) requires that the Army installation at the Presidio of San Francisco close and that approximately 1,234 acres of the Presidio transfer to the jurisdiction of the U.S. Department of the Interior. The draft plan and supporting information are being provided to the National Park Service for use in planning for the Presidio as part of the Golden Gate National Recreation Area. The Army is taking no further long-range actions for forest management at the Presidio. Forest management is one of the resource categories that will be addressed in the National Park Service's planning efforts to develop a general management plan for the Presidio.

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Chapter 1. Introduction

Purpose and Scope of Plan

The purposes of this forest management plan are to establish directions for management actions taken on the Presidio forest over a 20-year planning period (about 1990-2010) and to outline the direction of forest management in the decades that follow. This introduced forest, located at the windswept tip of the San Francisco peninsula (Figure 1-1), is now in a stage of advanced maturity and demands vigorous management action. A plan for its long-term care and evolution is also needed.

Included within the scope of this plan is vegetation in all open space lands of the Presidio managed by the U. S. Army, including forest stands, landscaping vegetation, and native vegetation. Because the forest vegetation is largely introduced at the Presidio, the plan scope must be wide. The plan is essentially a vegetation management plan, conforming to all U. S. Army requirements for a forest management plan (U. S. Department of Army Regulation 420-74 and Technical Manual 5-631).

Certain lands at the Presidio are no longer managed by the U. S. Army, and this plan does not apply to those lands. These exclusions include most of the coastal bluffs and beaches of the Pacific Ocean, the Fort Point National Historic Site, and most of the remaining bayshore, all of which are now managed by the Golden Gate National Recreation Area (GGNRA). Exclusions also include the San Francisco National Cemetery, managed by the Veterans Administration, and transportation corridors and the Golden Gate Bridge, Highway and Transportation District managed by the California Department of Transportation (Caltrans). The plan area is shown in Figure 1-2.

Relationship to Presidio Master Plan

This forest management plan is intended to be fully compatible with the Presidio Master Plan and to assist in its implementation. The plan provides direction for managing vegetation in both designated development areas and in designated open space areas (Figure 1-2), providing different approaches in each to reflect the differing management purposes.

Environmental Impact Evaluation

Adoption of this plan is an action of the U. S. Department of the Army subject to provisions of the National Environmental Policy Act (42 U.S.C. 4371 et seq.). Accordingly, an environmental assessment of the effects of implementing the plan is required (40 CFR

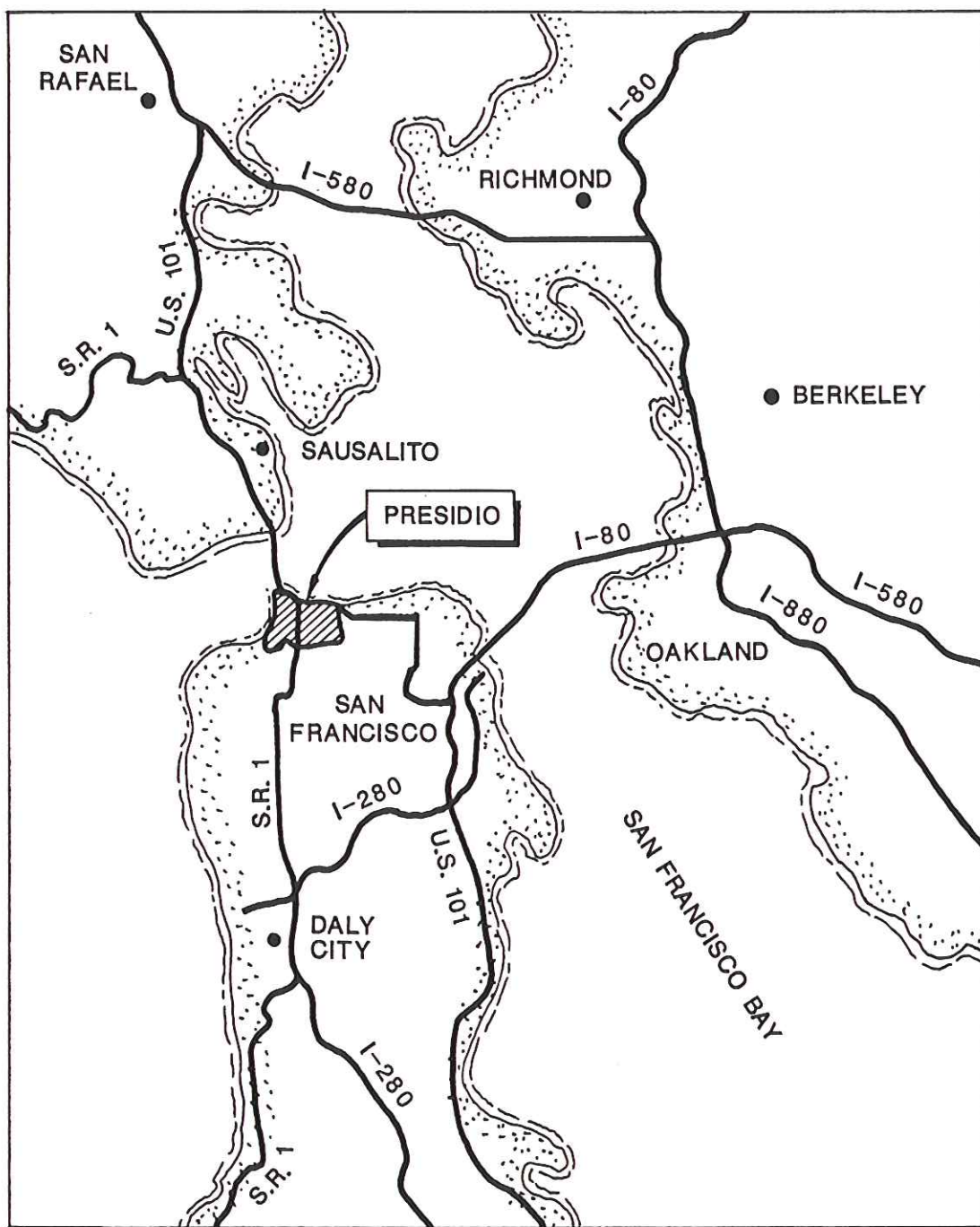
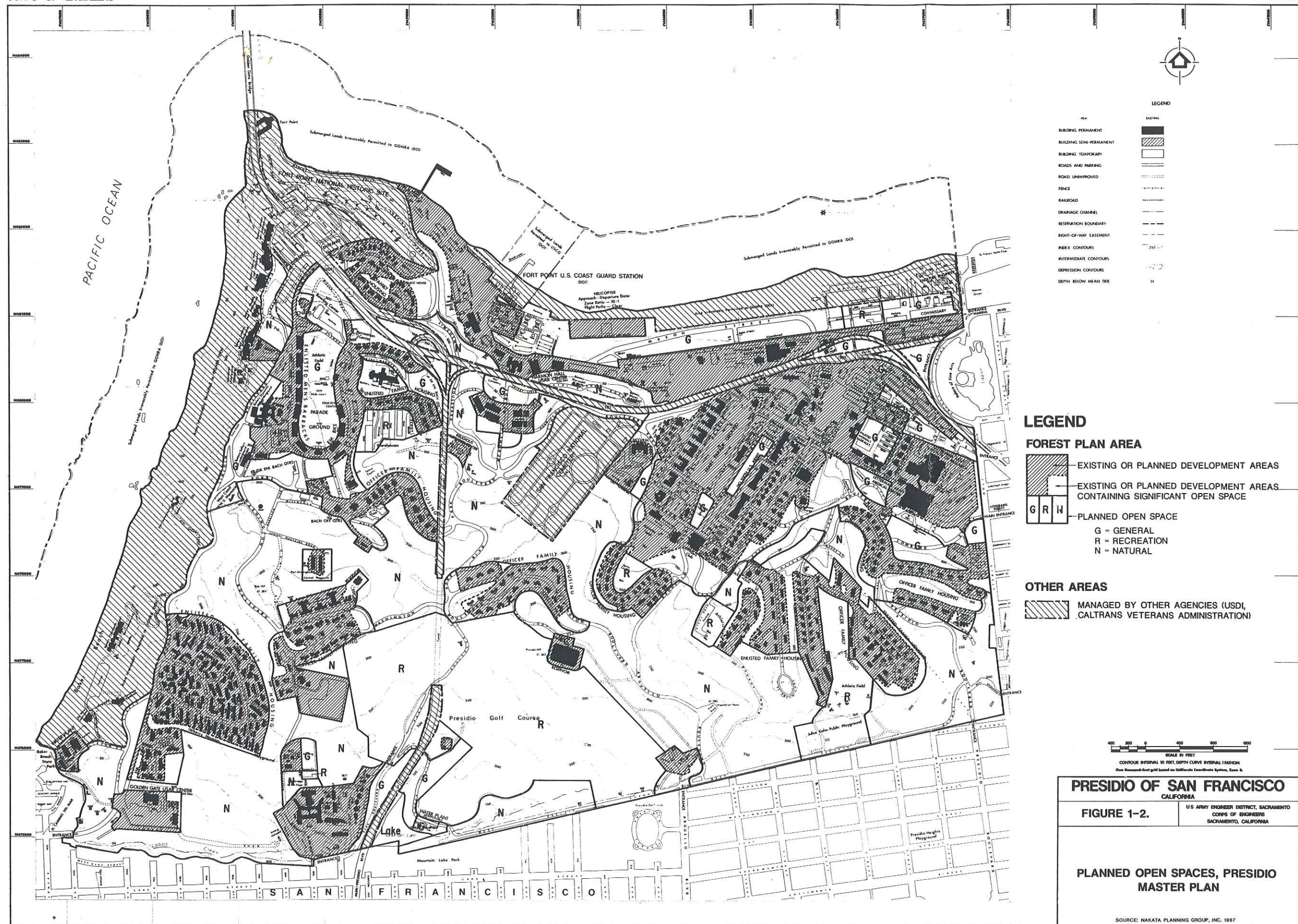


FIGURE 1-1. LOCATION MAP



otherwise be receiving maximum sunlight. By afternoon the fog has usually dissipated, and the west-facing slopes receive the full energy of the afternoon sun.

The variations in soil moisture and temperatures of the soil and the air are reflected in the distribution of vegetation. Slopes that face south and southwest tend toward chaparral and grassland; slopes that face north and northeast tend toward woodlands.

Wind Exposure. The specific effects of wind on the plants can be mechanical or physiological (Richardson 1943). Fairly continuous and often high wind movement significantly affects the distribution of the Presidio's vegetation. The region immediately along the ocean coast is most strongly affected. The wind-swept slopes facing southwest to the ocean are dominated by grasses and prostrate shrubs, and trees are found only in the sheltered valleys. Some trees, notably California bay laurel, can withstand high winds by assuming a prostrate form.

Regional topography is responsible for high winds at the Presidio. The gap in the Coast Ranges at the San Francisco Bay allows free movement of large volumes of air into the Central Valley. The dominant offshore winds throughout the year originate in the southwest and west, comprising about two-thirds of all winds. This pattern includes both cyclonic storm disturbances in winter and prevailing summer winds.

The wind-caused movement of the sand dunes affects established plant communities. W. P. Blake, one of the first to describe these dunes in 1857, observed that

on the Pacific side of the San Francisco peninsula there is an extensive sand-beach, reaching for several miles north and south, and a long distance inland. A wide area is thus covered by loose, dry, sea-sand, and it has the aspect and character of a desert. This sand is moved about by the wind and is constantly progressing inland, being thrown into wave-like hills, which move forward and bury shrubs and trees that lie in their path.

Most of the hills in the city and its vicinity, where they were partly sheltered from the wind, are, or were, covered with a thick growth of dwarf trees and shrubs, which prevented the wind from acting upon their surfaces and removing the sand . . . (which happens) whenever the vegetation is removed, or a cutting is made, and the wind is allowed to act upon the surface, or to strike a hill in a new direction. The motion of the sand is rapid, and a large hill is soon carried away and piles up in a protected place where the sand remains secure from further violent action (Cooper 1967).

Native Vegetation Distribution

The ocean influences combined with wind, topography, and the sandy substrate to create a mosaic of plant communities on the San Francisco Peninsula. Mixed evergreen woodlands, riparian woodlands, coastal prairies, coastal scrub, and coastal strand formed distinct botanical communities. Eastward of the ocean and the sand dunes was an extensive treeless area, but the hills and valleys of San Francisco were covered with a mosaic of marsh vegetation, grass, low live oaks, occasional other trees, chaparral, and a sparse scrubby growth (Clarke 1959).

The Anza expedition in 1776 described the area near Mountain Lake and the high tableland, including Fort Scott and extending northward to Fort Point, as treeless and covered with a growth of grass, yerba buena, lilies, and wild violets. The soil of this area is partly dune sand and partly a clay loam derived from serpentine, both of which were soils likely to be treeless.

Not far to the east of Mountain Lake there was an abundance of live oaks, which probably grew on Altamont clay loams that begin northeast of Mountain Lake and extend eastward. During the Spanish period the largest oaks and thickest chaparral of San Francisco probably grew on these hills, whereas the dune-sand areas to the north and south were largely covered with grass and other herbs. According to Behr, "the scrub of *Quercus agrifolia* now to be seen in the [Golden Gate] park fairly represents the original oak vegetation" (Howell et al. 1958). The live oaks were not evenly distributed on the hills but formed groves or clusters, mostly on north-facing slopes and in the arroyos.

It is difficult to determine from the Spanish accounts the exact distribution of these various types of vegetation. The later American accounts give specific locations and even provide lists of species for some of the vegetation types, but it can not be assumed that the vegetation remained unchanged throughout the Spanish and Mexican periods. Accordingly, Clarke (1959) used the diaries of the early explorers to determine the distributions of vegetation communities in the San Francisco Bay Area; excerpts from some of the diaries are presented in Appendix C.

Figure 2-1 shows probable native plant communities at the Presidio that existed prior to European settlement. It draws substantially from W. C. Clarke's (1958) work. This information, together with recent soil and geology delineations (SCS 1988; Figure 3-1), aspect, surface hydrology, and wind direction were used to delineate the probable distribution of each plant community. The figure also shows the surviving remnants of each plant community.

Vegetation Changes in the Spanish/Mexican Period

By 1820, the following trees and large shrubs had been described in the Presidio area by explorers:

<u>Scientific Name</u>	<u>Common Name</u>
<i>Arbutus menziesii</i>	Pacific madrone
<i>Heteromeles arbutifolia</i>	Toyon
<i>Myrica californica</i>	Pacific wax myrtle
<i>Prunus ilicifolia</i>	Hollyleaf cherry
<i>Umbellularia californica</i>	California bay laurel
<i>Quercus agrifolia</i>	Coast live oak
<i>Aesculus californica</i>	California buckeye
<i>Salix lasiandra</i>	Yellow willow
<i>Salix lasiolepis</i>	Arroyo willow

Thus, before the coming of the Europeans, the area now constituting the Presidio was apparently not completely denuded of tree cover, as reported by the first Americans in their journals, sketches, and photographs.

During the first 50 years of Spanish occupation, the direct activities of the inhabitants affected only certain areas. Agriculture was limited to the immediate vicinity of Mission Delores, and the Spanish inhabitants did not travel far beyond the established routes between settlements. Until 1835, when Yerba Buena was first occupied, the only settlements in San Francisco were the Mission and the Presidio. In their vicinity trees and brush were cut down for firewood, and live oaks were used to construct buildings, palisades, and furniture.

Eventually, however, the oaks, shrubs, and grasses that furnished acorns, berries, and grains to the local Indians quickly disappeared to meet the demands for timber, firewood, and forage. Herds of sheep, goats, cattle, horses, and mules were allowed to graze unhindered and uncontrolled, reducing the lush meadows to rocky, barren sand patches, and sand dunes.

The most widespread change in the vegetation during the Spanish period was a decrease in grass and a probable increase in brush--the result of years of heavy grazing by livestock. Although chaparral is mentioned in the early Spanish reports, abundant and good pasture is more frequently noted. The extensive chaparral mentioned in the later accounts was probably limited when the Spanish first arrived, but accounts from the 1840s suggest decimated pastures and a colonizing growth of chaparral. The dunes that had been stabilized by vegetation started moving again.

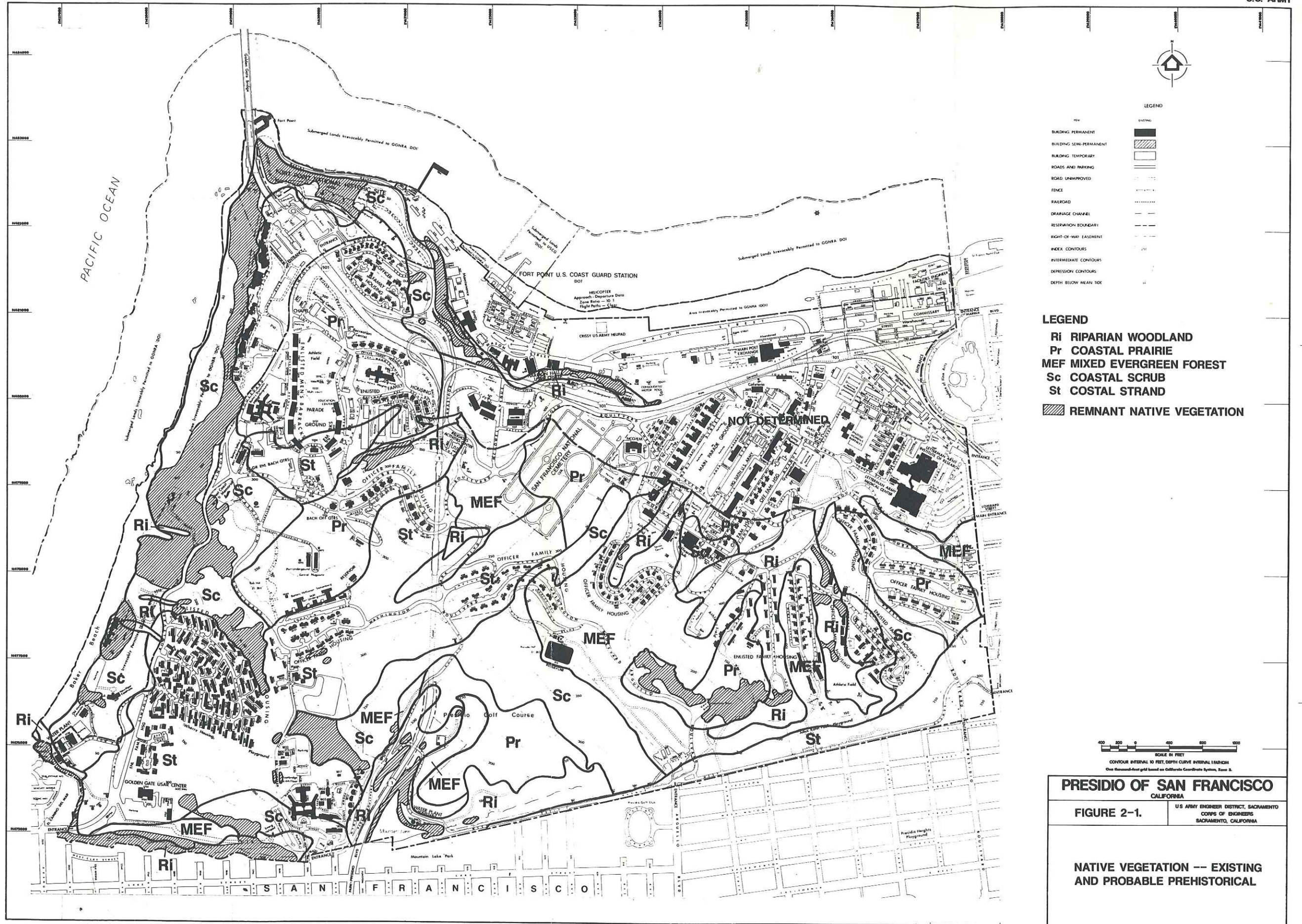
Vegetation during the American Period

By the time the U. S. Army occupied the Presidio, trees were few and primarily confined to the moister hollows and drainages remote from developments and sheltered from the wind. The Army officers and troops, most of whom were from the tree-covered eastern United States, found the Presidio a barren, bleak, windswept place (Straub pers. comm.).

Afforestation

In 1882-1883, Army Major W. A. Jones, under the direction of the Commander of the Department of the Pacific, developed a "Plan for the Cultivation of Trees upon the Presidio Reservation" (Appendix E).

The plan proposed a major tree planting program patterned after the successful efforts of the City of San Francisco's Golden Gate Park, begun in 1870. The primary idea of Jones' plan was to not only create a windbreak but "to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous, and thus appear larger than it really is." (Jones 1883)



The rectangular grid on which some areas of trees were planted is not called for in Jones' plan. It may have simply been used by others as a way of keeping trees sufficiently spaced when planted by unskilled troops or prison laborers, or it may have resulted from planting of horse-plowed furrows. This planting style has given the mature stands a unique military look.

Figure 3-2 of Chapter 3 shows the best estimate of the extent of the original plantings based on Jones' 1883 landscape design. It also shows those parts of the original plantings that are living today. The original map that accompanied Jones' report cannot be found. However, photos taken between 1890 and 1930, and a 1909 Army map of the Presidio, document the locations of many of the original plantings.

Post-Afforestation Changes

The Army appears to have followed Major Jones' recommendations approximately until 1910. Thereafter, additional planting and natural regeneration began to occur in some of the areas intended to remain open. Meanwhile, the wide variety of tree species planted at Jones' instruction was reduced to those species that proved able to survive the harsh site conditions, primarily Monterey cypress, Monterey pine, and eucalyptus. A few other species such as sycamore, and redwood survived in isolated, protected sites (Kruse pers. comm.).

After the Spanish-American War the Army built some military housing in parts of the windbreak forest. Most of the housing units did not significantly interrupt the windbreak function, and yet allowed Presidio residents the amenities of the forest--a visual screen from the city, a windbreak, and a rural-like environment.

The Presidio boundary plantings have been kept mostly intact. The forest was planted prior to adjacent private residential development, but in places it has matured to block Bay views of adjoining residences. Many of the boundary planting trees have been topped by neighbors from time to time. Although the Army was under no legal obligation to maintain private view corridors, it allowed some neighbors to top obstructing trees. In some areas this practice has stopped, but a few stands continually topped since they were very young have responded to this practice by forming a low, continuous, matted canopy.

Present Forest

Nearly all of the original forest stands at the Presidio have matured into the magnificent forest Major Jones envisioned more than 100 years ago. The limited development that has occurred in the originally forested areas has been designed and constructed with obvious sensitivity. The meandering streets and structures built on the contour are in marked contrast to the erect grid imposed upon the topography by the surrounding city. Today, the "contrast from the city" that Jones sought to maximize is quite apparent and successful.

Unfortunately, the forest has aged, and now many trees have exceeded their normal life expectancies. Natural regeneration is only occurring in limited areas. In the absence of intensified treatment, tree losses will continue to increase. Although eucalyptus and a few other stands may continue to expand, the overall extent of the forest will substantially diminish in the next two decades.

Current Management Policies

Management of the Presidio forest is primarily involved with maintenance of the introduced forest. Down material is removed from certain areas, and ground cover is mowed. Hazardous fuel accumulations are removed and all fire is suppressed. Trees in certain stands are pruned or removed to avoid or remove imminent hazards. Some of the more remote stands, however, grow relatively wild and are left relatively unmaintained.

A few neighboring landowners are permitted to top or prune specific trees on the Presidio to maintain or improve private views.

Current management does not include a program of forest regeneration or programs to maintain or enhance remnant native vegetation communities.

Current Forest Management Issues and Concerns

Through preparation of a forest management plan for the Presidio in 1983, a resource inventory by the American Society of Landscape Architects in 1986, and subsequent forest management, several dominant issues emerged that are related to the future of the Presidio forest. The sources of these concerns have been the Presidio staff, neighboring residents and other San Franciscans, environmental groups, the City and County of San Francisco, the GGNRA, and other agencies. These issues can be summarized as follows:

- o How can forest stands that serve as important windbreaks, soil stabilizers, and prominent visual components of the Presidio best be perpetuated?
- o Can existing forest stands and individual trees of high aesthetic and cultural value be nurtured through extended lifespans?
- o How can tree hazards to human safety or real property be adequately reduced?
- o Should areas supporting native plant communities and wildlife habitat be preserved and in some instances enlarged?
- o Can a diversity of forest stand ages be established to facilitate a steady maintenance program while also promoting a variety of wildlife uses?
- o How can the diversity of tree species at the Presidio be increased to improve visual quality and resistance to insect and disease infestation?
- o Can forest encroachment upon the Presidio's historical vantagepoints be reversed?

- o What measures should be taken to protect the forest from degradations due to disease, insects, soil erosion, wind, inappropriate treatments such as topping, or physical damage?

In Chapter 4, forest management policy is articulated in response to each of these issues and concerns.

Woodland and Forest Species

Native trees comprise about 5 percent of the Presidio. They are coast live oak, willow, wax myrtle, toyon, and holly leaf cherry (CNPS 1984). Records show that madrone, buckeye, and California bay, although no longer found, were also present in the limited native forests of the Presidio area (Clarke 1959).

The coast redwoods growing on the Presidio are not native to the site. Sites on the Presidio are too exposed to the drying influence of winds to allow redwoods to establish there naturally. Redwoods have been introduced from native populations in areas both north and south of San Francisco County.

Special-Status Plant Species

Twenty special-status plant species have been identified or may occur at the Presidio (Table 3-1). One species, the Raven's manzanita, is endemic exclusively to the Presidio. Another, the Presidio clarkia, is endemic to only the Presidio and the Oakland hills (across the San Francisco Bay). A third, the San Francisco lessingia, is only known to occur at the Presidio.

Only one naturally occurring individual of Raven's manzanita is apparently present, inhabiting an area near the top of the coastal bluffs above the Pacific in association with coastal scrub habitat. Additional individuals of the species have been propagated and planted in suitable areas. Clarkia apparently occurs only in association with the manzanita and in the sizable native coastal prairie grassland on the east-facing slopes below Inspiration Point. The lessingia occurs in open areas in the Lobos Creek Valley, south of the Old Nike site, and east of the Rob Hill summit. The Raven's manzanita and the clarkia occur on serpentine soils.

The other 17 special-status species shown in Table 3-1 either have one or more known locations at the Presidio, have been extirpated from the Presidio, or occur there but have not yet been located (Smith, Sue pers. comm.). Many are associated with serpentine soil. The CNPS, the U. S. National Park Service, and the California Department of Fish and Game (via the California Natural Diversity Data Base) maintain inventories of identified populations of these plants. Their locations are shown in the "Rare Plant Management District Guidelines" prepared by the U. S. National Park Service (Thomas 1986).

The Introduced Forest

As described in Chapter 2, most of the existing Presidio forest was planted, and its original distribution was part of a comprehensive forest plan. Exceptions are the native oak and willow stands which survived because the creeks and draws were considered forested at the time and were included unchanged as part of the landscape plan.

Table 3-1. Known or Potentially Occurring Special-Status Plant Species

Common Name	Scientific Name	Legal Status ^a	Habitat
		Federal/State/CNPS	
Laurel Hill manzanita	<i>Arctostaphylos hookeri</i>	C1**/-/1A	Coastal serpentine scrub
Raven's manzanita ^b	<i>Arctostaphylos hookeri</i> var. <i>ravenii</i>	E/E/1B	Serpentine chaparral; coastal prairie endemic to the Presidio
Marsh sandwort	<i>Arenaria paludicola</i>	C1/E/1B	Freshwater marsh
Coast rock cress ^b	<i>Arabis blepharophylla</i>	-/-/2	Coastal prairie and scrub; broadleaved upland forest
Point Reyes bird's-beak	<i>Cordylanthus maritimus</i> ssp. <i>palustris</i>	C2/-/1B	Coastal salt marsh ^d
Presidio clarkia ^b	<i>Clarkia franciscana</i>	C1/E/1B	Coastal scrub; valley and foothill grassland, often on serpentine endemic to the Presidio
San Francisco wallflower	<i>Erysimum franciscanum</i>	C2/-/4	Coastal dunes; coastal scrub, often serpentine
San Francisco gumplant ^b	<i>Grindelia maritima</i>	C2/-/3	Coastal scrub and bluff scrub; valley and foothill grassland
Marin dwarf flax ^b	<i>Hesperolinon congestum</i>	C1/-/1B	Serpentine grassland
Wedge-leaved horkelia	<i>Horkelia cuneata</i> ssp. <i>sericea</i>	C2/-/1B	Closed-cone conifer forest; coastal scrub
Beach layia	<i>Layia carnosae</i>	C1/E/1B	Coastal dunes ^d
San Francisco lessingia ^b	<i>Lessingia germanorum</i> var. <i>germanorum</i>	C1/E/1B	Coastal scrub endemic to the Presidio
Coast lily	<i>Lilium maritimum</i>	C1/-/1B	Closed-cone pine forest; coastal prairie and scrub
San Francisco owl clover ^b	<i>Orthocarpus floribundus</i>	C2/-/1B	Coastal prairie; valley and foothill grassland
San Francisco popcorn flower ^c	<i>Plagiobothrys diffusus</i>	C2*/E/1A	Valley and foothill grassland
Marin checkerbloom	<i>Sidalcea hickmanii</i> ssp. <i>viridis</i>	C2/-/1B	Chaparral
San Francisco campion	<i>Silene verecunda</i> ssp. <i>verecunda</i>	C2/-/1B	Coastal scrub; valley and foothill grassland

^a Status definitions:

Federal = U. S. Fish and Wildlife Service (50 CFR 17.12; 55 FR 6184, February 21, 1990).

E = Listed endangered under the federal Endangered Species Act.

C1 = A candidate species under review for federal listing. Category 1 includes species for which the USFWS has substantial information on biological vulnerability and threats to support the appropriateness of proposing to list them as threatened or endangered.

C2 = A candidate species under review for federal listing. Category 2 includes species for which the USFWS presently has some information indicating that proposing to list them as threatened or endangered is warranted but for which further biological research and field study are needed to determine biological vulnerability and threats.

* = Possibly extinct.

** = Believed to be extinct in the wild but extant in cultivation.

State = California Department of Fish and Game (1987).

E = Listed as endangered under the state Endangered Species Act.

CNPS = California Native Plant Society (Smith and Berg 1988).

1A = Presumed extinct in California.

1B = Considered rare and endangered in California and probably meets state definition for listing as rare, threatened, or endangered.

2 = Considered rare and endangered in California but more common elsewhere.

3 = Suggested for listing, but necessary information is lacking that would allow assignment to one of the other lists or to reject assignment.

4 = Considered rare but not endangered (species that do not presently meet state criteria for listing under the Endangered Species Act).

Chapter 3. Forest Inventory

Introduction

The Presidio's open space lands are largely occupied by planted forest stands. Other open spaces include landscaped shrubbery and lawns, areas of native vegetation, cleared areas, paved areas, and disturbed areas occupied by weedy vegetation. This chapter focuses on the Presidio's forests and remaining native vegetation communities.

This chapter describes the Presidio's forest in terms of site conditions; the native vegetation; forest establishment; forest evolution; the present forest in terms of species distributions, stand structures, and pathogenic influences; and the present forest condition and hazards. Wildlife habitats, visual resources, fire hazards, and soil erosion problems are also described.

Presidio Site Conditions

Wind, soil type, and precipitation patterns affect vegetation growth on the San Francisco peninsula. The Presidio is one of the harshest environments on the peninsula for tree survival. Its limited native woodlands were located near the creek and draw bottoms and in deeper moisture-holding soils on the north and northeast sides of the hills, sheltered from the constant salt-laden winds.

Wind

Wind constantly affects plant growth at the Presidio. Ocean winds are strongest during spring, when vulnerable new growth is emerging. The Presidio's native tree species have natural wind protection mechanisms, but most trees cannot protect themselves from the constant desiccation and salt damage and do not live long in areas exposed to the ocean wind. Four of the five species introduced at the Presidio, however, are well adapted to coastal environments.

Soil

Seventy percent of the Presidio soil consists of sand dunes or recently stabilized beach deposits (Figure 3-1) (SCS 1988). These sands are very low in soil nutrients and have low water-holding capacity. Trees surviving on sand must have an extensive, aggressive root system and the ability to "shut down" or decrease transpiration during dry periods. These trees must effectively use limited nutrients recycled by the soil and use the moisture in the soil provided by their own fog drip.

Fifteen percent of the soil is derived from serpentine. These ultrabasic soils often support unique ecosystems (SCS 1988) because of nutrient/cation imbalances. The several rare or endangered endemic plant species found on the Presidio grow in these soils. Blue gum eucalyptus, however, also survives well in this soil.

Rainfall

Annual rainfall varies on the Presidio from 12 to 24 inches. Most of this rainfall occurs during winter from December through March. This pattern and amount is similar to those of the Mediterranean climatic regions of the world. In addition, fog provides significant (although unmeasured) summer moisture and limits evapotranspiration losses.

Other Conditions

Mild annual temperatures, nearly frost-free winters, and cool summers are primary climatic determinants of vegetation survival and growth at the Presidio. These same factors also render unsuitable other tree species that, for example, need a frost to induce seasonal dormancy or that require a hotter, drier climate to control disease infestations.

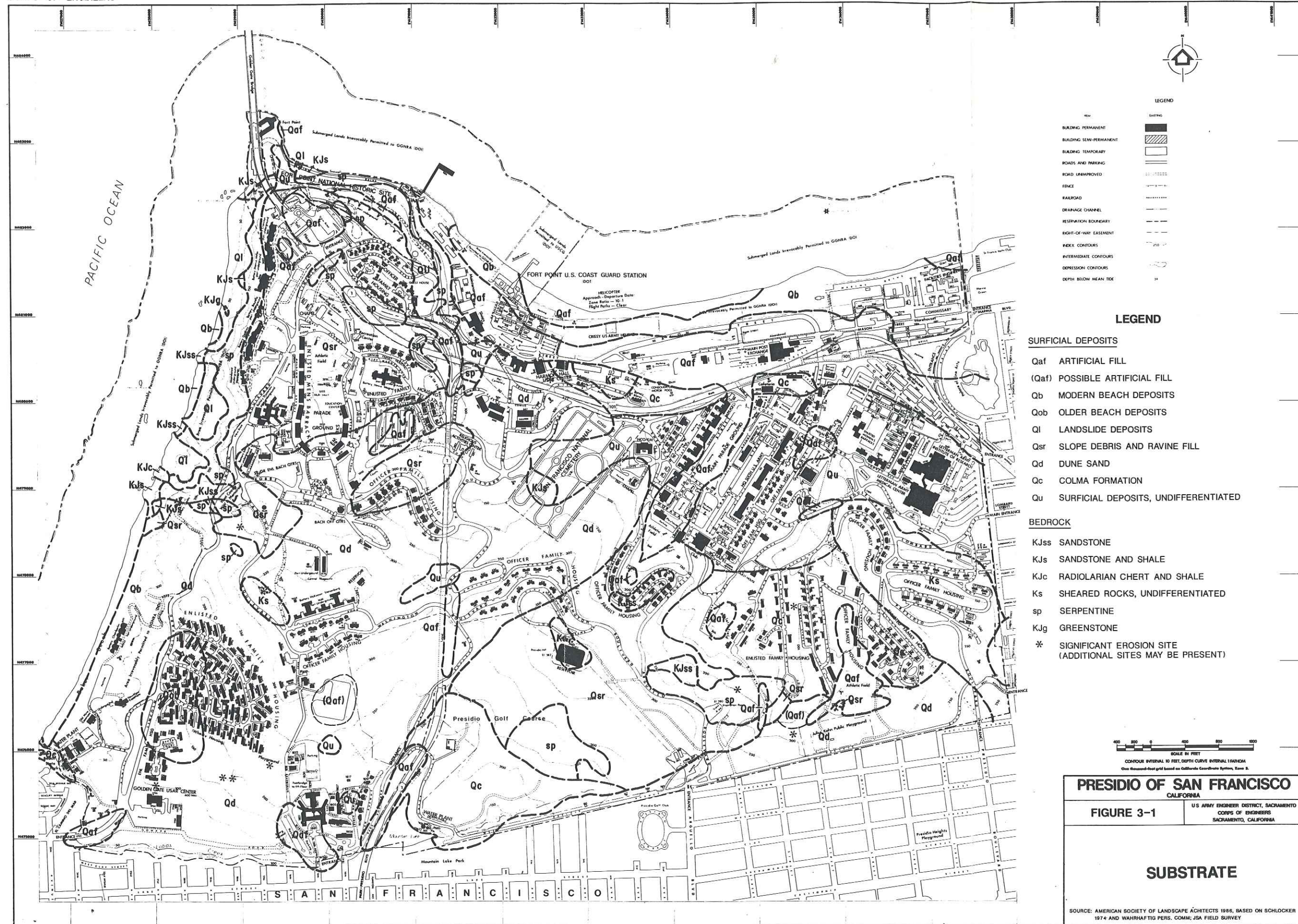
Native Vegetation Communities

Prior to disturbance by European settlers, the Presidio lands supported five native plant communities: northern coastal scrub, coastal prairie, coastal strand, coastal riparian woodland, and mixed evergreen forest. (Mayfield 1978, Clarke 1959). A range of soil conditions, slope aspects, and precipitation rates created suitable growing conditions for these diverse plant communities. The distribution of these communities is described and depicted in Chapter 2 (Figure 2-1). Today, only 5 percent of the Presidio not managed by the GGNRA (the plan area), or about 60-65 acres, supports native vegetation (Figure 2-1):

o	coastal riparian woodland	- 29 acres
o	coastal scrub and coastal strand	- 26 acres
o	coastal prairie	- 7 acres
o	mixed evergreen forest	- 2 acres

Many of these communities are small, fragmented, and subject to invasion by the dominant introduced species. Only the riparian woodland along Lobos Creek, Mountain Lake, and the larger patches of coastal scrub on the ocean bluffs can be considered large and stable enough to constitute a viable and unthreatened native habitat at present.

A unique flora evolved on the San Francisco peninsula because the area was isolated by water and sandy reaches on all sides. Moreover, fog drip provides summer moisture and increases the species diversity. These remnant floral communities contain more than 240 native species, including six tree species, according to the California Native Plant Society (CNPS). Many of these species are valued for their horticultural properties and could be used for maintenance or restoration efforts (Smith, Sue pers. comm.).



Introduced Forest Species

The original species list of the Presidio's cultivated forest is extensive, but only five of the introduced species have survived. These now make up 95 percent of the entire Presidio forest. They are Monterey cypress, Monterey pine, blue gum, blackwood acacia, and coast redwood. Dendrological descriptions of these introduced species are given in Appendix C.

The Monterey cypress, Monterey pine, and coast redwood are native to the California central coast, and the blackwood acacia and blue gum eucalyptus are native to the southern Australian coast and Tasmania. Although some are restricted to very limited areas in their native habitats, all five species have been used extensively in coastal Mediterranean-type climates for landscape and forest development.

Introduced Species Behavior in Native Habitats

The Monterey cypress and Monterey pine are fire-responsive species, reproducing most successfully in their native environments after a fire occurs (Vogl et al. in Barbour and Major 1977). Heat from the fire opens their cones and bares the land of competing vegetation. These trees grow quickly and reoccupy burned areas. Unfortunately, they also have relatively short lifespans (70-120 years). Overmature trees may become fire hazards, however, helping to perpetuate the fire-induced germination cycle.

The Australian trees, blue gum eucalyptus and blackwood acacia, reproduce both under a canopy and in available openings. Both trees can regenerate either from seed or by sprouting from stumps and roots. They also impede growth of most competing vegetation through chemicals exuded by their leaf litter (Hall et al. 1962).

Redwood, which occur on the Presidio only in sheltered areas with available moisture from fog and deep soils, reproduces by stump sprout or seed germination. However, the seeds often have a poor germination rate (Harlow 1978).

Original Plantings

About 85 percent of the Presidio forest acreage was planted. Although site conditions modified the original species selection, each species had a designated purpose in the landscape.

In the original "Plan for the Cultivation of Trees upon the Presidio Reservation" (Appendix E), Major W. A. Jones articulated the primary purpose of establishing a forest at the Presidio: to create a system of windbreaks. But he added what he considered to be important visual concerns: "the main idea is to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous and thus appear immensely larger than it really is. . . ." As planned "the eucalypti (should be) principally disposed along the crest of the ridge in order to increase, by their great height, the effect of the height of the hills." (Jones 1883.)

Major Jones also noted that "by leaving the valleys uncovered . . . the contrast of height will be strengthened." Moreover, he recognized the importance of leaving some of the grassy, prominent summits, such as Inspiration Point, free of forest trees to protect the expansive views. (Jones 1883.)

Accompanying the eucalyptus stands were stands of Monterey cypress; their role was to add a "dark mass" of greenery from the ground to where the eucalyptus towered above, giving the appearance of depth. The "bright flowering Acacia should be placed to light up the dark masses behind as seen from the Presidio (parade grounds)." (Jones 1883.)

Monterey cypress was used extensively on the southern borders, with masses of Monterey pine and eucalyptus used at the entrances. A "thin run" of eucalyptus was used on the eastern borders. On the larger areas of drifting sand and the ocean borders, Monterey pine and Monterey cypress were planted in masses, but in separate species groups. (Jones 1883.)

Several of the surviving stands are of representative historical interest today. Original entryway plantings are present at the Lombard Street, Arguello Avenue, and Presidio Avenue entrances. A stand of eucalyptus along Presidio Boulevard planted in a perfect grid demonstrates "the power of government" as Major Jones intended (stands 83, 84, 112, and 113 of Figure 3-3). The northernmost stands of the ridge windbreak system near the historical stables are particularly fine examples of these stands at maturity (stands 56, 59), and the windbreak stands immediately adjacent to the early buildings of the main post still serve their function (stands 69, 70).

Figure 3-2 shows the historic stands planted under Jones's direction as they relate to today's stands.

Golf Course Plantings

The Presidio golf course was planted after the initial Presidio landscape design was implemented. Plantings apparently occurred at various periods from the turn of the century onward. Mixed Monterey cypress and Monterey pine stands were used to delimit fairways and tees. Eucalyptus was used to form the course perimeter and comprises one large grove in the center of the course (Figure 3-3).

Evolution of the Forest

Introduced Forest

Succession. During afforestation of the Presidio, each stand was planted with only one species. Although monotypic stands still prevail, some of these stands now exhibit a diversity of species. Many species planted as windbreak shrubbery and dune stabilizers (leptospermum, photinia, pittosporum, beefwood, melaleuca, ceanothus, and lupine) for the most part are no longer present. The plants either became senescent and died, were shaded out, or were removed by staff. Accordingly, each stand has evolved, either in

response to management action or by natural succession, into its own unique plant community.

Regeneration. Planted Monterey cypress and Monterey pine have not reproduced well under their own canopies. In many of these stands, the ground cover is mowed or maintained in a park-like condition. In a few areas, Monterey pine, and occasionally Monterey cypress, have populated adjacent open spaces when conditions and maintenance practices have allowed. (Stands 120 and 139 of Figure 3-3 in vista areas, stands 90, 97, 129 in disturbed areas, stands 145 and 161 in unmaintained areas.)

Planted eucalyptus and acacia, on the other hand, have reproduced well under their own canopies where light has been adequate. More than half of the eucalyptus stands have expanded from their original planting sites. Acacias have a faster life cycle; in some cases stands have migrated considerable distances and completely abandoned their planting sites.

Ground Cover Development. The ground cover under Monterey pine and cypress stands has been limited to grasses and forbs because of the frequent mowing, noted above.

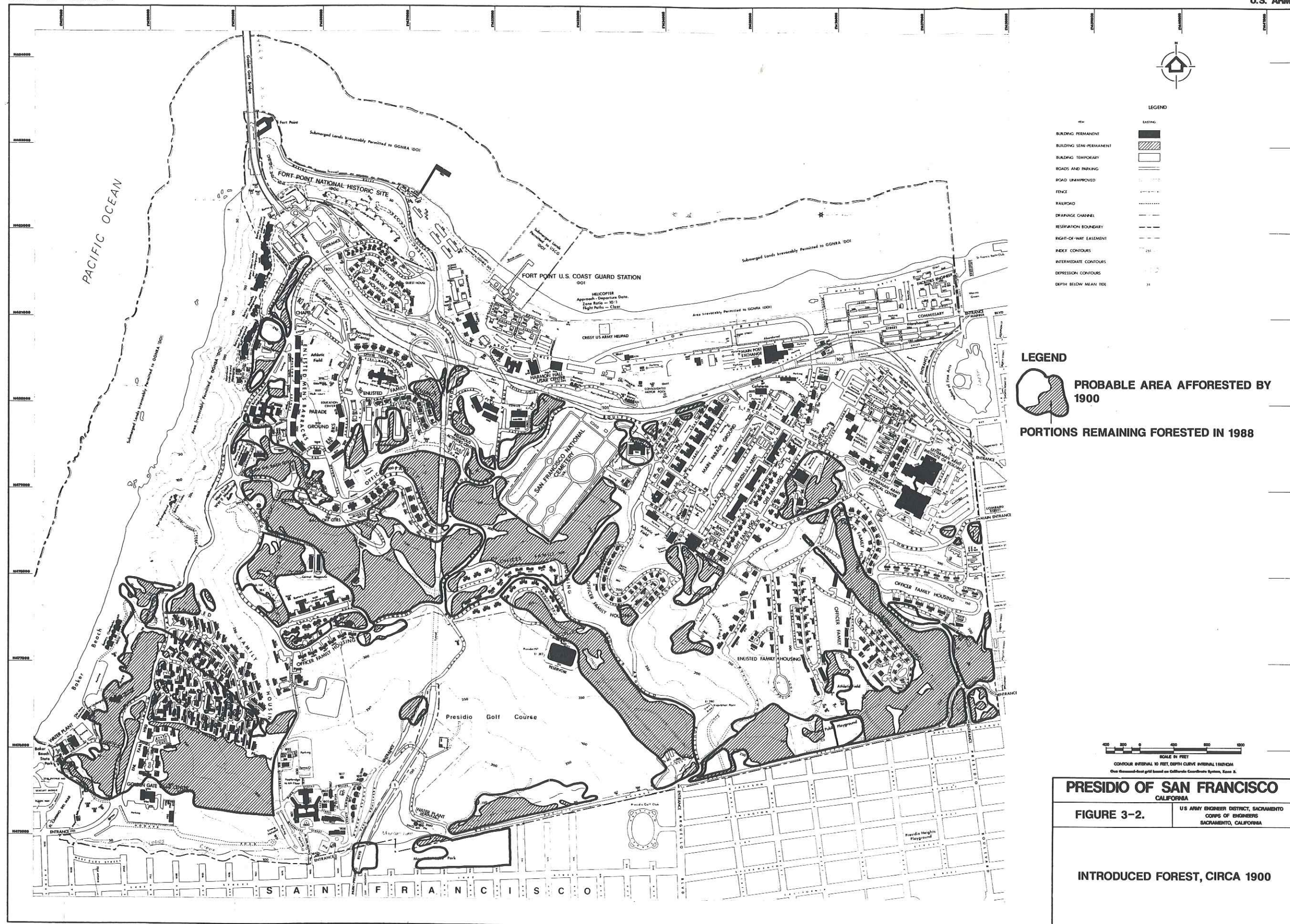
Ground cover varies greatly under the eucalyptus, depending on the seed productivity of associated vegetation, maintenance by the Presidio staff, canopy density, and litter accumulation. On soils derived from weakly cemented surficial deposits (the Coloma formation), ivy, Himalayan berry, and holly dominate the eucalyptus understory. On ultrabasic soils derived from serpentine, native trees such as toyon and holly leaf cherry are found with the ivy and blackberries in the understory. On the dune sands, grasses, forbs, and a few blackberries constitute the understory.

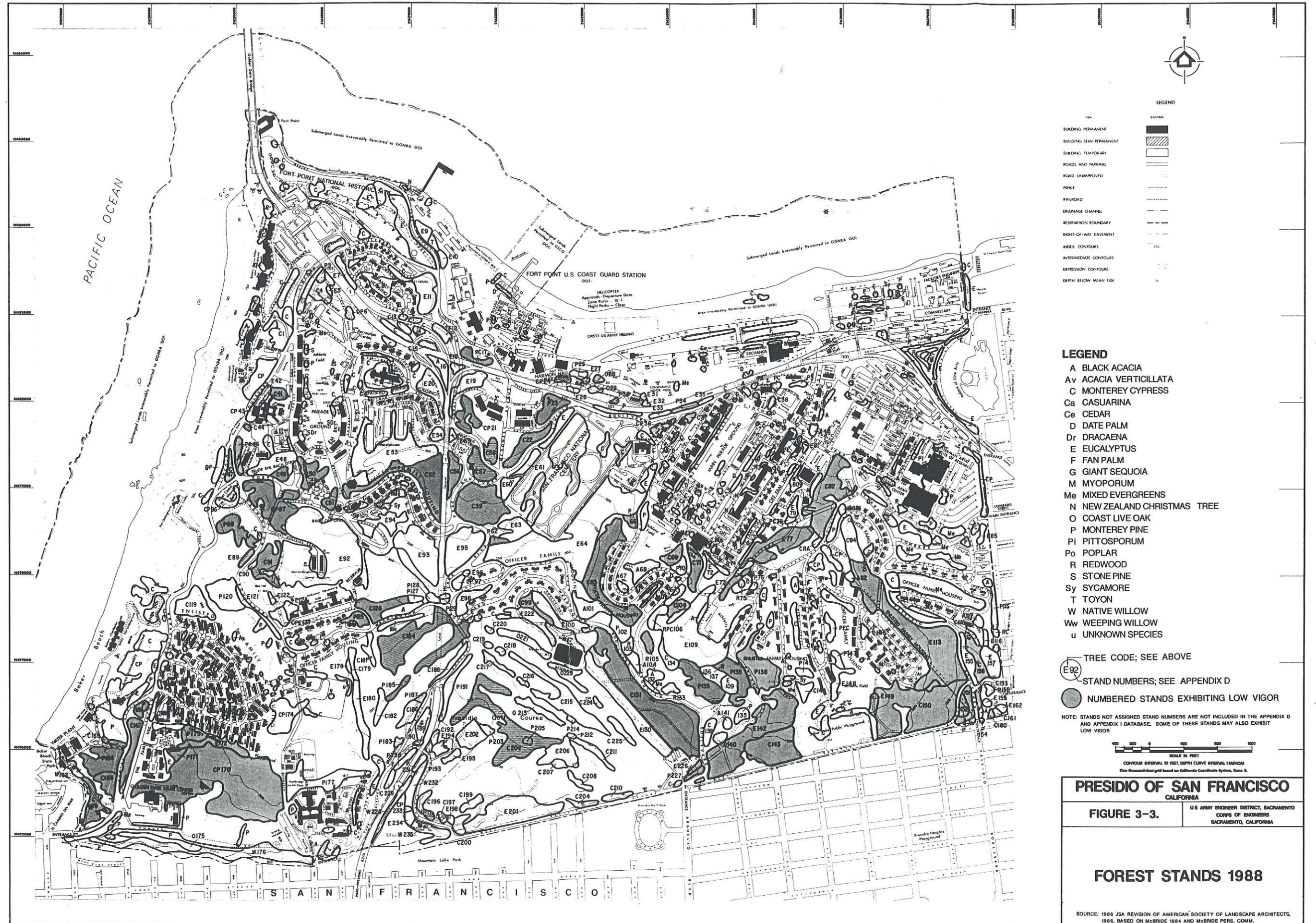
Naturalized Stands

"Naturalized" stands are those that have expanded their range into other stands or adjacent open areas. Six naturalized stands of Monterey pine and eucalyptus (stands 109, 134, 135, 120, 121, and 160 of Figure 3-3) have invaded valleys and vista areas which were intended to remain open under the original forest plan. Naturalized stands vary greatly in species composition, age, health, and size. Since they have colonized adjacent areas aggressively and without management, most of these mixed stands are in poor condition. Unlike the mixed species stands dominated by the pine, the naturalized eucalyptus stands tend to be monotypic.

Native Woodland

Native willow, wax myrtle, and oak stands persisted only in the riparian area adjacent to Lobos Creek and Mountain Lake. As noted above, toyon and holly leaf cherry are growing in isolated pockets under the canopies of the eucalyptus.





The Present Forest

Forest Mensuration

Measurements of tree densities and volumes at the Presidio, as well as observations of other stand characteristics, were made in 1984 (McBride 1984). These data, based on the delineation of 235 individual stands, provide a quantitative basis for the analysis and conclusions drawn in this chapter. Each of McBride's stands represents a group of trees possessing sufficient uniformity in species composition, structure, arrangement, age and condition to be distinguishable from adjacent stands (Figure 3-3). As discussed earlier, most of these stands were planted, although some stands comprise native woodland.

A summary of the inventory and the 1984 forest plan appears in Appendix B of this plan. The inventory data, updated in fall 1988 for purposes of this report, appear in Appendix D.

Species Volumes and Distributions

The Presidio forest contains about 3.5 million cubic feet of wood, distributed primarily among the prevalent eucalyptus, Monterey cypress, and Monterey pine.

Eucalyptus stands dominate the Presidio forest, covering 42 percent of the forested acreage (Table 3-2). The eucalyptus makes a similar contribution to total wood volume. Cypress stands, while somewhat less extensive (34 percent), make a contribution to total wood volume equal to that of the eucalyptus. The pine and mixed species stands contribute only 10-20 percent, both in terms of acreage and volume.

Tree volumes are affected by substrate conditions, but the effects are species-dependent (Figure 3-4). On the droughty and nutrient-poor dune sands, for example, cypress growth appears somewhat suppressed, but eucalyptus and pine growth rates are approximately normal for these species. Acacia volumes are relatively high on the dune sands. On the serpentine soils, most of the tree species grow poorly or not at all. The principal exception is eucalyptus, which appears to grow moderately well in this unique geochemical environment.

Stand Structures

Because most of the Presidio forest was planted during a relatively short period, the introduced forest is essentially of a single age class, or "even aged." The native stands, however, tend to be of several age groups, or "uneven aged".

Even-Aged Stands. Since most of the planted forest is nearly the same age, the forest has matured uniformly and will probably experience concentrated periods of high mortality throughout the forest. Because very little reproduction is occurring within the stands, this situation has resulted in a classical even-aged forest. Even-aged stand structures are natural for Monterey pine and Monterey cypress, which usually require a fire or other natural catastrophe for reproduction.

Table 3-2. Tree Distribution by Species, Area, Frequency, and Volume

	Species							Total
	Eucalyptus	Cypress	Pine and Mixed	Willow	Redwood	Acacia	Oak and Others	
Acreage	124	99	51	9	4	5	1	293
(% of forest stands) ^a	(42)	(34)	(17)	(3)	(1)	(2)	(1)	(100)
Number of trees	21,623	17,135	11,187	16,164	481	3,458	187	70,235
(% of forest stands) ^a	(31)	(24)	(16)	(23)	(1)	(5)	(1)	(100)
Wood volume ^b	1,483	1,465	493	1	36	35	1	3,514
(% of forest stands) ^a	(42)	(42)	(14)	(-)	(1)	(1)	(-)	(100)

^a Percentages may not sum to 100 due to rounding.

^b Thousands of cubic feet.

^a Percentages may not sum to 100 due to rounding.

^b Thousands of cubic feet.

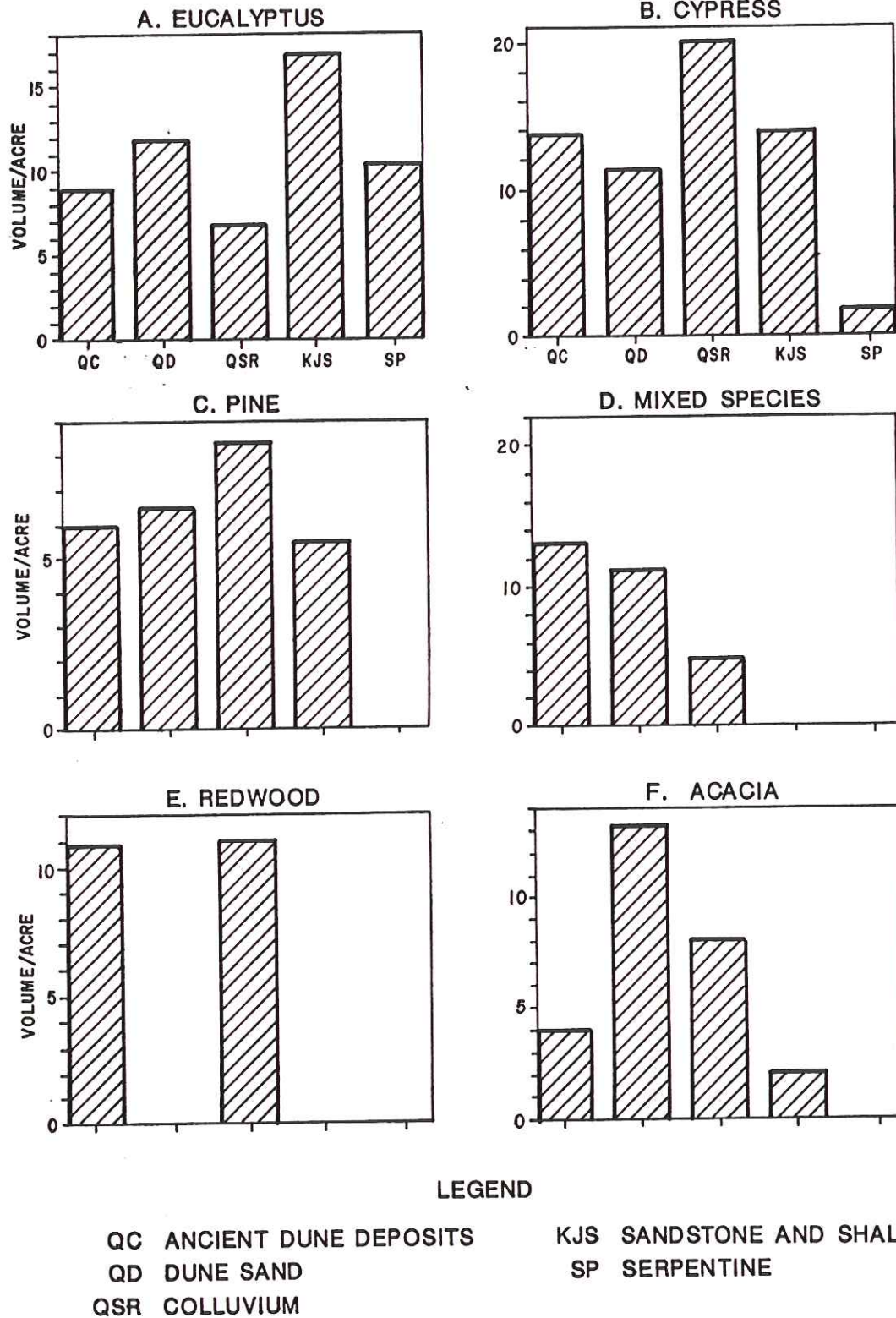


FIGURE 3-4. SPECIES VOLUMES IN RELATION TO SUBSTRATE
(VOLUME/ACRE IN THOUSANDS OF CUBIC FEET)

Eucalyptus in its native environment is also considered to form even-aged stands (Hall et al. 1962). Although the Presidio eucalyptus stands originated as even aged, they appear to be evolving into uneven-aged stands.

Uneven-Aged Stands. The native willows and oaks in the Lobos Creek area often form uneven-aged stands. But because oak regeneration at the Presidio has been poor, the oak stands are tending toward an even-aged, old-growth structure. The willows are short lived, but reproduce prolifically. They have the classical uneven-aged pattern: many young trees and few old trees. The naturalized eucalyptus stands also exhibit uneven-aged structures.

The Monterey cypress and Monterey pine stands that have expanded into open spaces have a mix of ages and will continue as uneven-aged stands for several more decades. Once stand canopies close, stands could evolve into an even-aged structure because of inhibited reproduction.

Pathogenic Influences

The Presidio forest is subject to several pathogenic influences considered in this section: insects, biotic diseases, abiotic diseases, and weeds. Abiotic diseases are one of the primary problems facing urban forest managers but are little understood and diagnosed. With most tree deaths in the Presidio forest, evidence of insects, biotic diseases, and abiotic diseases is usually present.

The following sections describe the pathogenic influences in the Presidio forest, closing with a discussion of major pathogenic problems that may face future forest management.

Insects. Many kinds of insects are constantly at work in the forest and are causing a steady drain on the forest resource (Furniss and Carolin 1977). A few species of insects periodically become epidemic and kill trees over extensive areas. This has not occurred at the Presidio.

For every tree species, specific insects attack either the roots, bole, branches, needles/leaves, or cones/seeds. Particularly destructive insects on the Presidio are noted in Table 3-3 by species and tree part attacked. The most important insects, those that can become epidemic, are further described in Appendix F.

Most of the insects listed in Table 3-3 are endemic to the forest, but normally occur in numbers too limited to attack healthy trees successfully. When stress stemming from disease (biotic or abiotic) or advanced age triggers a decline in tree vigor, the insects can irrupt and cause serious economic and aesthetic losses in an otherwise seemingly healthy forest. As the Presidio forest becomes older and more decadent, the incidence of debilitating insect attacks will probably increase (Smith, Stephen pers. comm.).

Biotic Diseases. Biotic tree diseases are classified as mistletoes, bacteria, fungi, and viruses (Bega 1978). Since the forest was planted at the Presidio, many of the diseases common among the various tree species in their native habitats have apparently not become established.

Table 3-3. Important Insect Pests of the Presidio Forest

Insect	Location	Frequency of Occurrence on Presidio	Likelihood of Mortality if Infested
Monterey Pine			
Monterey pine cone beetle (<i>Conophthorus radiatae</i>)	cones	high	low ^a
Western pine spittlebug (<i>Aphrophora permutata</i>)	twigs and needles	moderate	moderate
Tent caterpillar (<i>Halisidota argentata-sobrina</i>)	needles	moderate	low
Monterey pine needleminer (<i>Argyasthia pilatella</i>)	needles	moderate	low
Monterey pine weevil (<i>Pissodes radiatae</i>)	bark and tips	moderate	low
Sequoia pitch moth (<i>Vespamima sequoiae</i>)	bark	low	high
Red turpentine beetle (<i>Dendroctonus valens</i>)	bark	moderate	high
Ips (<i>Ips</i> sp.)	bark	low	high
California flatheaded borer (<i>Melanophila californica</i>)	boles and limbs	low	moderate
Monterey Cypress			
Cypress bark moth (<i>Laspeyresia cupressaria</i>)	cones and twigs	moderate	moderate
Cypress tipminer (<i>Argyresthia cupressella</i>)	twigs	moderate	low
Cypress leaftier (<i>Epinotia subviridis</i>)	needles and twigs	moderate	low

Table 3-3. Continued

Insect	Location	Frequency of Occurrence on Presidio	Likelihood of Mortality if Infested
Cypress bark beetle (<i>Phloeosinus custatus</i> and <i>P. cupressi</i>)	bark	moderate	moderate ^b
Blue Gum Eucalyptus			
Eucalyptus longhorn borer (<i>Phoracantha semipunctata</i>)	bark	not present	high
False powderpost beetle (<i>Polycaon stoutii</i>)	deadwood	moderate	low
Coast Live Oak			
California oak worm (<i>Phryganiolia californica</i>)	leaves	moderate	moderate
Pit scale (<i>Asterolecanium minus</i>)	twigs	moderate	low
Western tussock moth (<i>Orgyia vetusta</i>)	twigs	low	moderate
Orange tortrix (<i>Argyrotae citana</i>)	leaves	low	unknown
Coast Redwood			
Redwood bark beetle (<i>Phloeosinus sequoiae</i>)	bark	not present	moderate

^a Usually results in mortality only in conjunction with pine pitch canker, which is not known to occur on Presidio.

^b Usually results in mortality only in conjunction with cypress canker, which occurs with moderate frequency.

Tree diseases usually move through a forest more slowly than insects, but, once established, they often persist, creating long-term problems. Wind and water are the most common vectors of disease transport, but insects also transport some diseases. Disease diagnosis is based on identifying symptoms and studying occurrence patterns.

Debilitating diseases usually occur in older trees. An example is *Polyporus basilaris*, a heart rot, that occurs in 80 percent of Monterey cypress trees 65 or more years old throughout this species' range (Bega 1978). Trees less than 30 years old are usually rot free.

Root diseases are difficult to diagnose, yet can cause serious damage to trees. Root diseases are generally nourished by landscaping irrigation, which is widespread at the Presidio. When root strength becomes insufficient to support trees, public safety and property are endangered. Root diseases, primarily armellaria, attack all of the major tree species at the Presidio and pose the most dangerous pathogenic problem to the forest.

As with insects, specific diseases affect particular sections of particular species. The most important, or common diseases, are given in Table 3-4, and the symptoms of the most critical diseases are described in Appendix G.

Abiotic Diseases. Abiotic diseases are nonorganic, nonliving, noninfectious diseases. Trees are captive to all ambient environmental conditions because they cannot move. Some of these conditions can be direct causes of tree mortality, whereas others allow biotic diseases and insects to enter the tree and indirectly cause decline or death. Abiotic diseases result from either natural or man-caused factors.

Natural abiotic disease factors on the Presidio are wind (having both mechanical and physiological effects), salt, drought, soil erosion, dune movement, mineral deficiency (in dune sands), toxic mineral concentrations (as from serpentine substrate), prolonged high and low temperatures, fire, and animal damage.

Salt-laden wind constantly prunes the forest, especially the redwoods, oaks, and cypress. A combination of high rainfall and unusual shear wind crossed the Presidio in 1983 uprooting 600 trees. In autumn or early winter 1988, a strong north wind caused the loss of 200 trees. Low temperatures caused losses in 1973 when a snowstorm caused widespread injury to eucalyptus tops.

Gophers are a problem in some of the Presidio's landscaped areas and in Golden Gate Park where they were the most destructive factor affecting survival of native and ornamental plantings.

Human-caused abiotic disease agents on the Presidio are mechanical injury (mower and tractor damage), soil compaction, filling and excavating for construction, paving, root cutting, and pruning. Some of these factors are causing tree injury and occasional tree loss. Such injuries and losses can often be avoided.

Weeds. Other pests of the forest are aggressive weeds that compete successfully for limited resources. Weeds can be especially competitive with tree seedlings. Weeds, as well as escaped landscaping plants such as German ivy, French and scotch broom, and pampas grass, are the most debilitating pests of the Presidio native plant communities. The CNPS

Table 3-4. Important Tree Diseases of the Presidio Forest

Disease	Species Affected	Section Affected	Frequency of Occurrence on Presidio	Likelihood of Mortality if Affected
Bole and Root Diseases				
Armillaria root disease (<i>Armillaria mellea</i>)	all	root	moderate	high
Annosus root disease (<i>Fomes annosus</i>)	conifers	root	low	high
Shelf fungus (<i>Fomes applanatus</i>)	hard-woods	root	moderate	high
"Velvet top" fungus (<i>Polyporous schweinitzii</i>)	oaks, eucalyptus and pines	root	low	moderate
Water molds (<i>Phytophthora</i> spp.)	hard-woods	root	moderate	moderate
Crown gall (<i>Agrobacterium</i> spp.)	oaks and eucalyptus	root	low	low
Western gall rust (<i>Peridermium harknessii</i>)	pinos	bole	moderate	moderate
Cypress canker (<i>Coryneum cardinale</i>)	cypress	bole	moderate	high
Pine pitch canker (<i>Fusarium subglutinans</i>)	pinos	bole	not present	high
Oak wilt (<i>Ceratocystis fagacearum</i>)	oaks	bole	not present	high

Table 3-4. Continued

Disease	Species Affected	Section Affected	Frequency of Occurrence on Presidio	Likelihood of Mortality if Affected
Heart Rots of Boles and Limbs				
White pocket rot (<i>Fomes pini</i>)	pinos	bole	moderate	high
Cypress heart rot (<i>Polyporus basilaris</i>)	cypress	butt	high	high
Sulfur fungus (<i>Polyporus sulphureus</i>)	eucalyptus and oaks	bole	high	moderate
Brown cubical rot (<i>Poria sequoiae</i>)	redwoods	bole	low	low
Tinder fungus (<i>Fomes igncarius</i>)	eucalyptus and oaks	butt	low	moderate
Red belt fungus (<i>Fomes pinicola</i>)	pinos	bole	low	low
Large branch dieback (<i>Diplodia quercina</i>)	oaks	limb	not present	moderate
Twig blight (<i>Cryptocline cinerescens</i> and <i>Discula quercina</i>)	oaks	limb	low	low
Leaf and Needle Diseases				
Needle cast (<i>Lophodermium pinastri</i>)	pinos	canopy	moderate	low
Red band needle blight (<i>Scirrhia pini</i>)	pinos	canopy	moderate	low
Powdery mildew (<i>Spaerotheca lamestris</i>)	oaks	canopy	moderate	moderate

Table 3-4. Continued

Disease	Species Affected	Section Affected	Frequency of Occurrence on Presidio	Likelihood of Mortality if Affected
Anthracnose (<i>Gnomonia</i> spp.)	hard-woods	canopy	high	low
Dwarf mistletoe and true mistletoe (<i>Arceuthobium</i> spp. and <i>Phoradendron</i> spp.)	all	canopy	low	low

has developed a list of weeds in San Francisco, identifying those that threaten the native vegetation (Table 3-5). This list includes some cultivated plants that have escaped their original planting sites. These species should not be used for revegetation or landscaping on the Presidio.

Potential Major Pathogenic Problems. Three pests may pose serious problems to future forest managers at the Presidio.

Eucalyptus Borer. This insect (*Phoracantha semipunctata*) is one of the most significant potential threats to the Presidio forest. It was formerly confined to the Los Angeles basin (Luck and Scriven 1986), but has recently been reported in Contra Costa and Alameda Counties ("Eucalyptus Borer Confirmed in the Bay Area" 1989). If a pest such as the eucalyptus borer enters the Presidio's older eucalyptus forest, significant losses could occur, reducing affected stands to patchy groups of only young trees.

The costs of such insect-caused mortality could be high. Removal of one large dead eucalyptus in a sensitive location could cost several thousand dollars. The cost to control a eucalyptus borer epidemic and remove hazardous trees at the Presidio would probably be over a million dollars. This amount does not include the value of aesthetic losses or the costs of reforestation.

Pine Pitch Canker (Fungus). In 1987, pine pitch canker (*Fusarium subglutinans*) had its first outbreak in recent history (25 years) in the Monterey Bay area. The canker quickly spread to the San Francisco Bay Area for the first time, traveling by water-borne spores that infected state highway plantings of Monterey pine along the way. A single infected tree was identified in San Francisco at the Harding Park Golf Course and was removed. Little is known about this new disease, except that it moves quickly and can ultimately kill the Monterey pine and other closed-cone (fire) pines--sometimes within a 3-month period. (California Department of Forestry and Fire Protection 1987)

Some Monterey pines are relatively resistant to the effects of the pine pitch canker, and certain climatic conditions must exist before an outbreak can occur. Insects such as cone borers and bark beetles work in conjunction with the canker to cause mortality.

Costs to Caltrans to remove approximately 400 trees along its highways in 1988 exceeded \$400,000, not including reforestation costs (Claypool pers. comm.). Since Monterey pine occurs extensively along the roadways of the Presidio, the costs of an epidemic could greatly exceed those of Caltrans' limited outbreak. Early identification would be the most cost-effective tool for control.

Cypress Canker (Fungus). The cypress canker (*Cloronyneum cardinale*) has kept the Monterey cypress from growing very far inland from the coast in its native habitat. It is believed that ocean spray may prevent the canker spore from successfully germinating (Vogl et al. in Barbour and Major 1977). In areas where the climate is warm or dry, the Monterey cypress has been virtually eliminated from the landscape. Cypress bark beetles are often associated with this disease, hastening the death of infected trees.

The canker is endemic to Golden Gate Park. Reforestation of dry, south-facing sites has been difficult because of this disease under certain climatic conditions. Where debilitating infections have occurred, these sites have been replanted with other species.

Table 3-5. Weedy Species in San Francisco

Common Name	Scientific Name
Albizia	<i>Albizia lophantha</i>
Andean pampas grass	<i>Cortaderia jubata</i> [*]
Australian fireweed	<i>Erechtites prenanthoides</i> [*]
Bermuda buttercup	<i>Oxalis pes-caprae</i> [*]
Bermuda grass	<i>Cynodon dactylon</i>
Black acacia	<i>Acacia melanoxylon</i>
Blue gum	<i>Eucalyptus globulus</i>
English ivy	<i>Hedera helix</i>
European beach grass	<i>Ammophila arenaria</i>
Everlasting pea	<i>Lathyrus latifolius</i>
French broom	<i>Cytisus monspessulanus</i> [*]
German ivy	<i>Senecio mikanioides</i> [*]
Giant reed grass	<i>Arundo donax</i>
Gorse	<i>Ulex europaeus</i> [*]
Himalayan berry	<i>Rubus procerus</i>
Ice plant	<i>Carpobrotus edulis</i>
Myporum	<i>Myoporum laetum</i>
Periwinkle	<i>Vinca major</i>
Red valerian	<i>Centranthus ruber</i>
Round leaf ice plant	<i>Conicosia pugioniformis</i>
Scotch broom	<i>Cytisus scoparius</i>
Sow thistle	<i>Sonchus oleraceus</i> [*]
Spanish broom	<i>Spartium junceum</i>
Sidney golden wattle	<i>Acacia longifolia</i>

^{*} Exceptionally invasive and threatening to native plant communities.

Source: Smith, Sue pers. comm.

If the canker becomes established at the Presidio, it will become a long-term problem. This disease could become a particularly troublesome for young trees in reforestation plots.

Careful monitoring of the Presidio forest, together with prompt action, can prevent possible outbreaks of this disease. In similar circumstances, the complete reforestation of 20 canker-affected plots in Golden Gate Park cost nearly \$150,000 in crew time to replant and maintain the plantations over a 3-year period (Smith, Stephen pers. comm.).

Present Forest Condition and Hazard

In this section, the present condition of the Presidio forest is described. The analyses of stand vigor described herein are based on the McBride stand inventory (McBride 1984), a hazardous tree inventory of the Presidio commissioned by the U.S. Department of the Army in 1988 (Hermann Zillgens 1988), and on field surveys by the authors of this report. A summary of the two previous studies appears in Appendix B.

Forest Condition

Much of the Presidio forest is in an obvious and serious state of decline. On an acreage basis, only 8-9 percent of the forest stands exhibit high vigor, while 45 percent show low vigor (Figure 3-5). On a total volume basis, only 5 percent of the forest exhibits high vigor, while 50 percent shows low vigor (Figure 3-6). Based on numbers of trees, this decline is less pronounced: 33 percent have low vigor (Figure 3-7).

The relative vigor of the eucalyptus stands is substantially higher than the forestwide average, but the cypress and mixed species stands are much less vigorous. On a volume basis, low vigor is evident in 65 percent of the cypress stands, 51 percent of the pine stands, nearly 90 percent of the mixed species stands, but only 30 percent of the eucalyptus stands (Figure 3-6).

The cause of forest decline is not attributable to a particular pathogenic influence or stress factor; the decline is primarily the result of the advanced age of most trees. As described earlier, statistical analyses of forest condition included an examination of the importance of soils and geology to the vigor of Presidio forest stands. These analyses and observations of pathogenic influences reveal that none of these factors is controlling forest vigor. On the other hand, vigor is clearly related to tree maturity. For nearly all stands, those with the largest trees are least vigorous.

In the absence of stand treatments and individual tree care, most trees in the "low" vigor class would be expected to live no more than another 20 years. Thus, without significant forest management, the Presidio forest could decline in extent by 45 percent by 2005. The largest acreage loss would be from the cypress stands, although eucalyptus losses would also be substantial. Relative to their present abundance, acreage losses from the mixed species and cypress stands would be the most severe.

The volume of woody debris requiring removal would exceed 1.7 million cubic feet, or about half of the present volume of all trees in the forest. Removal and disposal costs

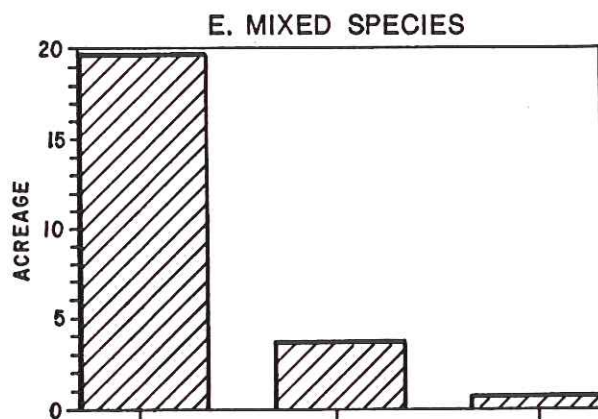
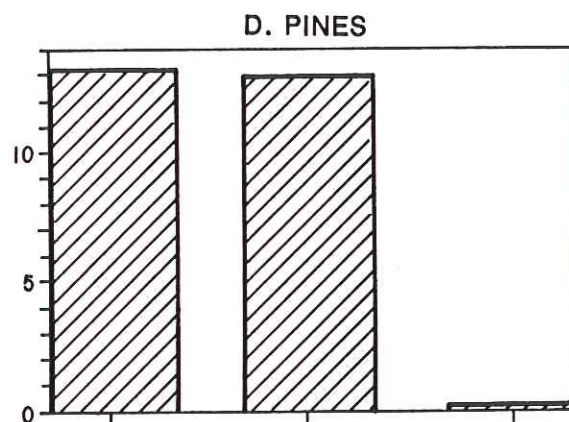
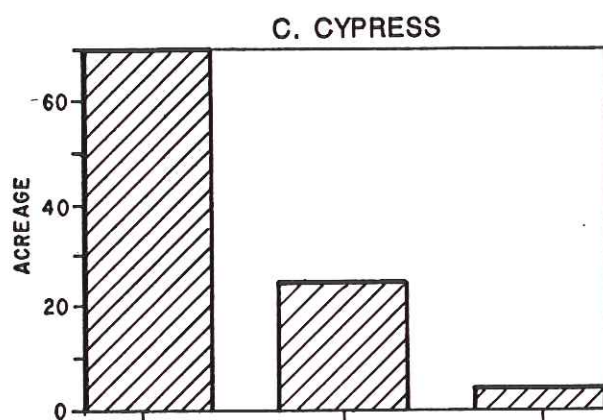
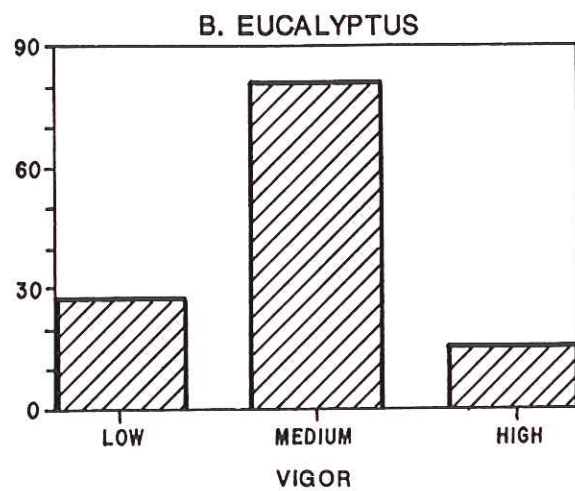
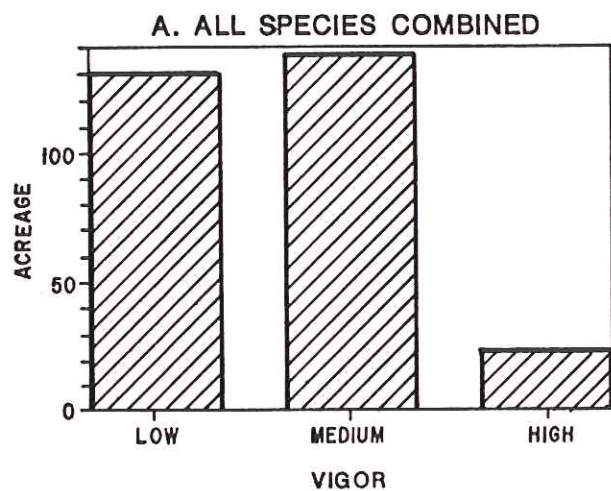
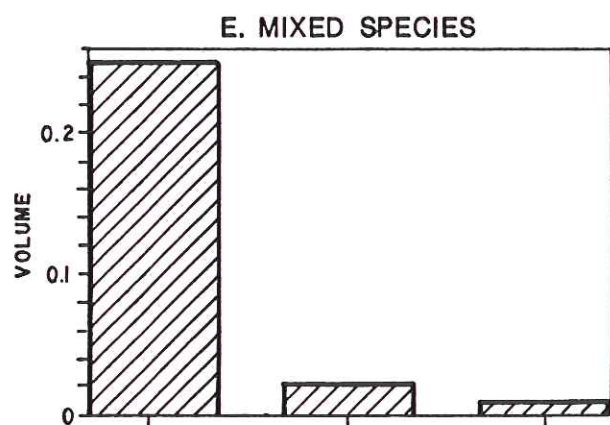
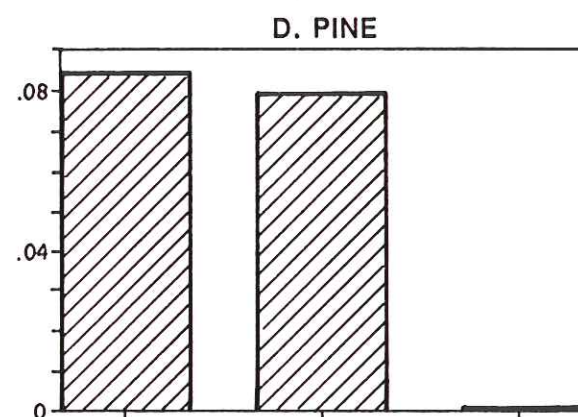
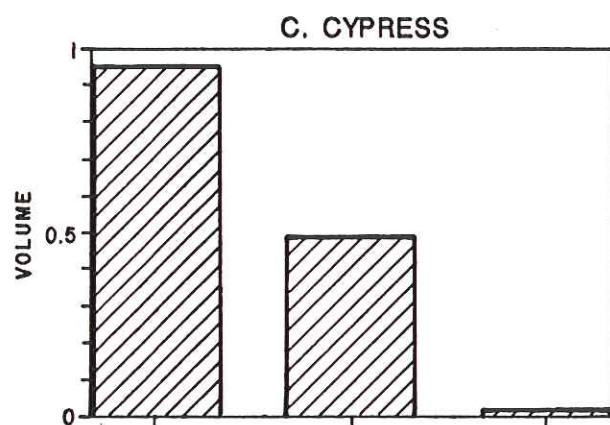
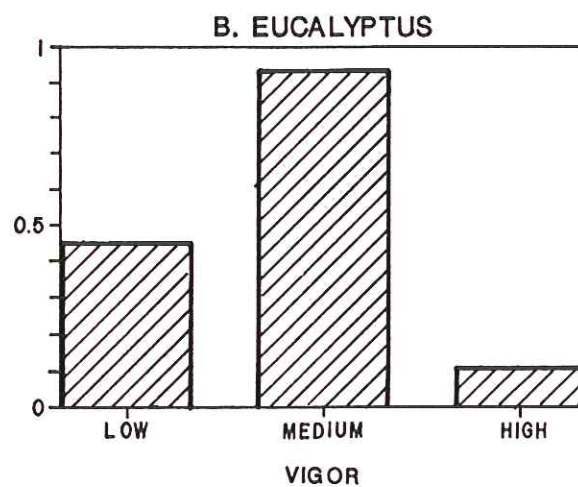
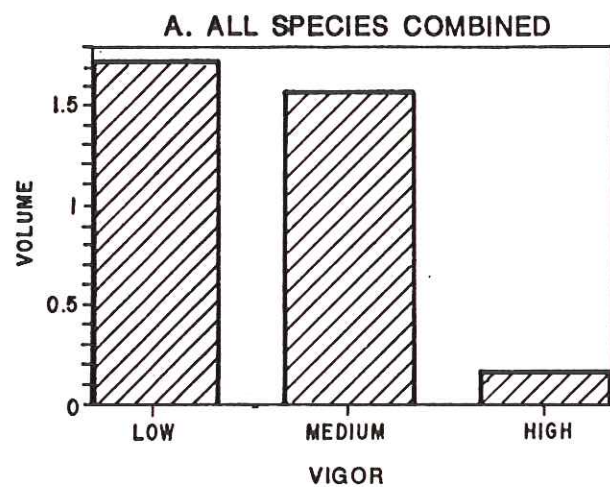
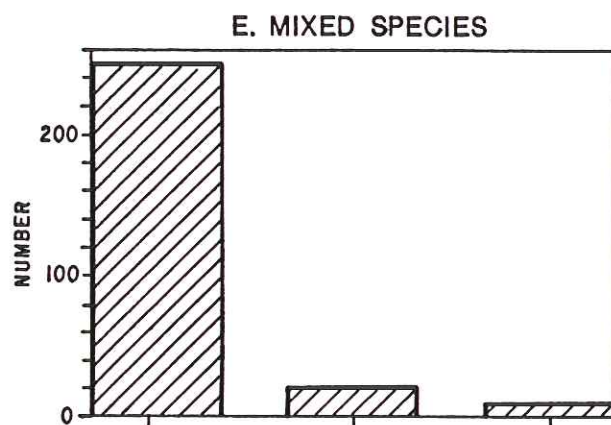
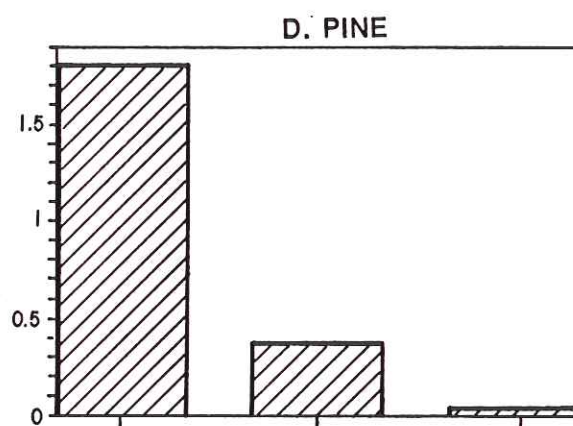
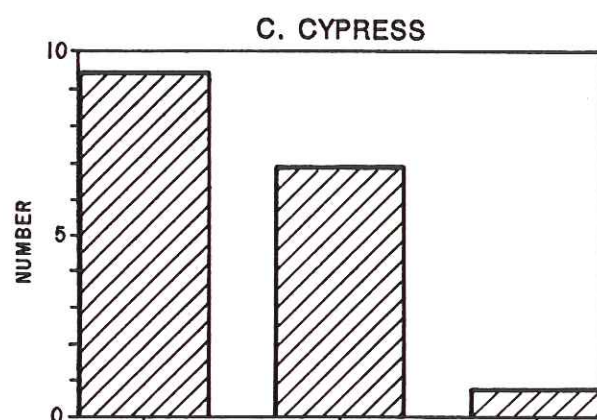
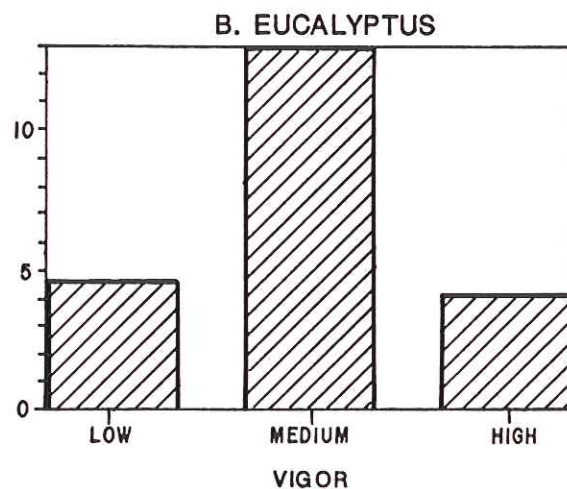
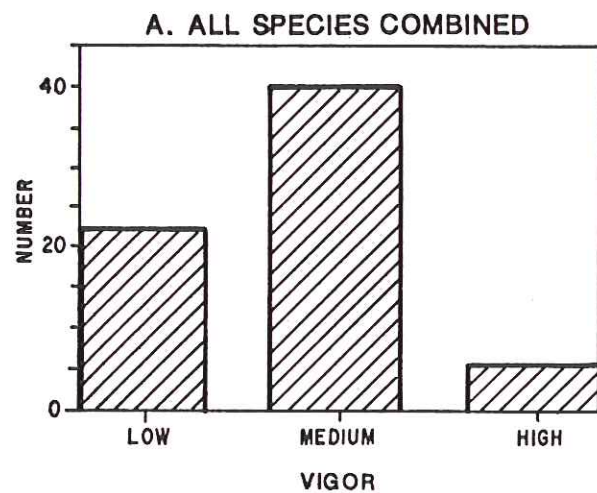


FIGURE 3-5. FOREST CONDITION BY ACREAGE



**FIGURE 3-6. FOREST CONDITION BY WOOD VOLUME
(VOLUME IN MILLIONS OF CUBIC FEET)**



**FIGURE 3-7. FOREST CONDITION BY NUMBER OF TREES
(NUMBER IN THOUSANDS)**

would be high, but the aesthetic changes and loss of the windbreak function would be even more significant.

Hazardous Tree Occurrences

"Hazardous" trees are trees likely to fail within 5 years during normal storms and cause property damage or personal injury. The numerical hazard rating system used in San Francisco reflects both the probability of tree failure and the nature and proximity of surrounding activities and properties. Accordingly, most hazardous trees are landscape trees, growing either in the vicinity of developed facilities or along roadways. The Presidio has a total of about 7,000 landscaping trees, according to the hazard tree inventory (Hermann Zillgens 1988).

In the inventory, over 1,000 of the landscaping trees have been classified as hazardous at the Presidio. Of these, approximately 600 would be considered priority hazard trees, according to the hazard rating threshold used by the City and County of San Francisco. Field studies for preparation of this plan indicate that some additional hazardous trees have been omitted from this classification, but their number has not been estimated.

The hazardous tree inventory data reveal the degree of hazard that might be expected from a particular tree species and which parts of trees of each species are most likely to fail (Table 3-6). The data indicate that the blackwood acacia is the most hazard-prone species in the landscaped areas (although the species' inherent failure potential is somewhat masked by the locational factors in the inventory data set). The Monterey pine appears to have the lowest rate of potential failure (subject to the same uncertainty noted). Pine failure, however, usually occurs at the roots or bole rather than the branches, magnifying the potential for serious damage.

Eucalyptus and Monterey cypress together constitute nearly two-thirds of landscaping trees at the Presidio (Table 3-6). Whereas the cypress constitutes only about one-quarter of the Presidio's forest, it accounts for fully one-third of the landscaping trees. Clearly, bole failure of the cypress is the dominant threat, although the potential for limb failure cannot be ignored. In contrast, almost 90 percent of the eucalyptus hazard is associated with falling limbs.

Species-Specific Hazards

Monterey Cypress. Monterey cypress presents a serious hazard for bole and large branch failure. These trees, growing outside of their native habitat, have greatly surpassed their natural form, growing taller and spreading further than is structurally sound. They often develop multiple boles, each of which may support large branches. Branch weight may eventually exceed the bole's strength, causing both the branch and bole to split away from the remaining trunk.

The Monterey cypress root systems are generally unable to support trees taller than 50 feet. They lack tap roots for structural support, and when the surface soils are saturated, these trees blow over very easily (Smith, Stephen pers. comm.).

Table 3-6. Relative Hazard of Landscaping Trees

Species	Proportion of Landscaping Trees (%)	Part of Tree Most Likely to Fail			Proportion of Trees Rated Hazardous (%)
		Roots (%)	Bole (%)	Limbs (%)	
Acacia	4	0	78	21	7
Cypress	32	6	70	24	5
Eucalyptus	30	5	6	89	5
Pine	18	42	33	25	3
Other	16	a	a	a	5

Note: Data based on unadjusted hazard rating of 200 or greater (Hermann Zillgens 1988).

^a Insufficient data available for other species evaluation.

Monterey Pine. The Monterey pine is subject to several types of failure: root rot, poor limb development, and bole failure related to cankers caused by western gall rust. Thus, all parts of the tree are significant candidates for failure. However, the failure rate of this species, as noted, is relatively low.

Blue Gum Eucalyptus. Like Monterey cypress, eucalyptus has grown so rapidly outside its native environment that its weight often exceeds its structural capacity (Shigo 1986). Fortunately, the eucalyptus currently has no debilitating pests, except *armellaria mellea*, a root disease, and the longhorn eucalyptus borer. As noted above, branch failure of the eucalyptus is a constant hazard; branches are usually very high and heavy.

Blackwood Acacia. This short-lived tree has very brittle branches that frequently break off. Most older trees have significant rot in the bole. Acacias must be pruned frequently or replaced (preferably with another species) because of their short life span.

Coast Live Oak. Most of the native oaks on the Presidio are very old and contain some heart rot. As young, healthy trees, these natives do not represent much potential hazard. Unfortunately, when cultivated in irrigated areas, they tend to develop root or bole rot and their potential for causing damage increases accordingly.

Wildlife Habitats

The Presidio provides remnant wildlife habitat within the urbanized environment. The scarcity of such habitats magnifies the relative importance of the Presidio's habitat, most of which has been substantially altered by man and is non-native forest. The surviving native wildlife species must generally be tolerant of human activity, since few areas are undisturbed by man's presence for more than brief periods.

The native riparian woodland along Lobos Creek, and other native plant communities within the Lobos Creek watershed, provide the most undisturbed habitat and would be expected to support the greatest diversity of native wildlife species.

Although the predominantly monotypic composition of the cultivated forest is not conducive to wildlife diversity, the large number of individual stands, interspersed by grassland, scrub, landscaping, and other areas, serves to promote species diversity. For example, over 160 species of birds are present at various times of the year, and about 40 species breed here (ASLA 1986).

Deer or other large mammals are not known to be present within the Presidio, but raccoon, opossum, squirrel, rabbit, skunk, shrew, mice, gophers, moles, and bats are present (Royston et al. 1975). Noteworthy potential visitors to the Presidio include the peregrine falcon, southern bald eagle, California least tern, ferruginous hawk, and osprey (ASLA 1986).

Special-Status Wildlife Species

Other than the potential visitors mentioned, only one wildlife species that is a candidate for listing as threatened or endangered by state or federal wildlife agencies is known to occupy the Presidio grounds: the San Francisco tree lupine moth. Populations of tree lupine, primarily at Baker Beach under GGNRA jurisdiction, provide critical habitat for this species.

Recreational Resources

In addition to developed recreation facilities for Army personnel, the Presidio offers excellent opportunities for dispersed recreation. Because the Presidio is an open base, these opportunities are generally available to the public. Most of these opportunities are associated with those portions of the base that have been transferred to the GGNRA for administration: Baker Beach, most of the coastal bluffs, Fort Point, and the Golden Gate Promenade. This plan does not address management of any areas under GGNRA administration.

Small playgrounds, tennis courts, and athletic fields throughout the housing areas of the Presidio are under Army jurisdiction. Julius Kahn Park, along the southern edge of the Presidio, provides additional, similar facilities under management of the City and County of San Francisco. The park is readily accessible to local neighborhoods south of the Presidio, and, like the adjacent city-managed Mountain Lake Park abutting the Presidio nearby, it is used heavily by San Franciscans (ASLA 1986). Maintenance of stands and individual trees in all of these areas is a concern of this plan.

The Presidio Golf Course provides 18-hole golfing in a well-maintained, forested setting. The use of planted stands to delimit the course was described earlier. The upper reach of Lobos Creek lies within the designated golf course boundary, but a significant portion of this reach is wooded and not developed as fairway. The golf course is jointly operated by the Army and the Presidio Golf Club, a private group. Accordingly, maintenance of forest vegetation at the golf course is done independently of general maintenance of the Presidio forest. Nonetheless, management of golf course forest stands is a subject of this forest plan.

In addition to trails along the coastal bluffs and through bayside areas managed by the GGNRA, trails also have been developed in forested portions of the Presidio, bringing users into portions of the forest not accessible by roadway. The Ecology Trail in the southwestern portion of the base is an example. These walkways are used by base personnel, local residents, and Presidio visitors for walking, bicycling, jogging, and exercising of pets.

Visual Resources

The Presidio is a major visual resource of the San Francisco Bay Area. Together with Golden Gate Park to the south, it brings to San Francisco an element of the natural landscape.

The visual resources of the Presidio can be considered from four perspectives: regional vantage points, major highways passing through the post, adjoining neighborhoods, vista points, and other interior viewpoints. All of these visual elements of the Presidio were recently evaluated in detail by the American Society of Landscape Architects (ASLA 1986).

Regional Landmark

From regional perspectives, the Presidio is seen as a large tract of dark green, wooded hills that separate the whitewashed city from the graceful orange-colored spans of the Golden Gate Bridge and the blue of the Pacific Ocean. Although intensively developed for Army activities, the Presidio is perceived as a forested garden atop ocean bluffs and bayside uplands standing in marked contrast to the surrounding urban landscapes.

As a regional landmark, the Presidio can readily be seen from the Golden Gate Bridge, the Marin Headlands, several Marin County bayside communities, the north waterfront of San Francisco, high rises in the financial district, and hill summits in the city such as Twin Peaks. In most of these views, the Presidio appears as a densely forested series of low ridges as described above. Individual stands for the most part cannot be differentiated in these views. Only large-scale forest removal operations would be noticed from these perspectives.

Highway Views

U.S. Highway 101 and State Route 1 pass through the Presidio, joining near the approach to the Golden Gate Bridge. Forest stands are seen in the foreground and middleground from these routes. Various stands screen Presidio developments from view. Since the roadways are elevated in some areas and are at ground level in others, the screening function varies between canopy and understory vegetation. Stand treatments along the roadways may not be noticed by rapidly passing highway travelers, but they could eliminate current visual screening of post facilities or enhance the visibility of historical structures.

Neighborhood Views

The Presidio is bordered on the east and south by residential neighborhoods. Thus, forest vegetation along these perimeters is plainly visible from these public use areas.

Several multistory residences along or near the southern border afford expansive views of the Presidio forest and the bay, ocean, and the Golden Gate Bridge beyond. To

preserve these views in the face of Presidio tree growth, several of these residents have periodically topped certain stands near Julius Kahn Park. This activity has been most persistent east of the park to the vicinity of Walnut Street. For the most part, these actions have been undertaken with approval of the base commander, but a plan to guide this uncoordinated forest management has not been formulated.

Because this area is plainly visible to visitors who use the park, as well as to adjoining residents, significant public attention would focus on any forest management activities in this area.

Presidio Vistapoints

The Presidio forest is constantly visible throughout public use areas within the post. Only a few stands are not visible from some point along the many roadways and walkways, throughout the base. Some interior portions of the extensive windbreak stands along the central ridgeland are only visible to the dedicated forest explorer, but nearly all forest management activities could probably be seen from commonly used areas within the Presidio.

Three vista points have been designated along the interior roadways of the Presidio. Paved turnouts are provided at these locations. These vistas are at Inspiration Point, along Washington Boulevard on the western slope of Rob Hill, and on Lincoln Boulevard overlooking Crissy Field. Although the original forest was established in such a manner as to maintain scenic vistas from these locations, over the years naturalized forest stands have markedly encroached upon the views from Inspiration Point and Rob Hill.

Forest management activities immediately adjacent to these vista points would be quite visible, as would treatments to more distant stands west, north, and east of Inspiration Point.

Fire Hazards

Because moisture from fog drip reduces the impacts of summer drought at the Presidio, wildfire has had little effect on the structure or health of the Presidio forest. Although climatic conditions occasionally produce high hazard conditions, such episodes are infrequent.

Fuels do develop by litter fall in the unmanaged eucalyptus windbreak stands and other stands, or approximately 10 percent of the forest area, but periodic removal of fallen branches and mowing of understories in many stands inhibits fuel accumulation.

At least three forest fires have occurred in recent years, but their acreages were small. The Army maintains a modern fire suppression capability on the base, and naturally pursues a policy of fire exclusion in the forest. Fuel treatment by prescribed fire is not practiced.

Soil Erosion Problems

Because much of the Presidio substrate consists of sands of eolian origin (Figure 3-1), the establishment of the Presidio forest greatly reduced the potential for wind erosion of the area's soils. However, these soils, especially the unconsolidated dune sands, are highly erodible when exposed to either wind or running water. In most areas, forest litter is effective in protecting the soil surface from water erosion, but where litter is removed and slope is appreciable, soil erosion becomes significant.

The most significant soil erosion is occurring on steeply sloping (22 percent) recent dune deposits (stand 170 of Figure 3-3). This dune is located in the southwest portion of the Presidio on a hillside northeast of the Golden Gate U. S. Army Reserve Center and west of the old Public Health Hospital. The introduced cypress forest casts enough shade to prevent the persistence of native ground cover or development of non-native cover, and is accelerating the degradation of its habitat. A network of actively eroding gullies in the sandy substrate among the aging trees now characterizes the site.

Significant soil erosion is also occurring on the slope below Pacific Avenue. Sheet and gully erosion have stripped substantial material from the root systems of existing cypress trees, causing the death of several trees.

Several sites displaying significant soil erosion were noted during stand inventory for preparation of this plan (Figure 3-1). Most of these sites have sandy soils, either recent dune sands or older beach deposits. The two sites on bedrock-derived soils are eroding due to uncontrolled vehicle use.

Chapter 4. Forest Management Goals and Guiding Policies

Organization of Forest Management Policies

Policies of this forest management plan are articulated in several components. forest management goals set forth the purposes of forest management activities. Forest management guiding policies establish the general policies that are adopted to implement the forest management goals. The goals and guiding policies presented in this chapter form the "constitution" of this forest plan.

Implementing policies are in two parts. Emphasis area policy and objectives entail allocation of various portions of the Presidio forest to different management emphasis areas, principally to address the several management issues and concerns described in Chapter 2. The objectives are quantified targets for management activities through time for each emphasis area. Emphasis area policies and objectives are given in Chapter 5.

Best forest management practices, on the other hand, apply throughout the forest, specifying the set of practices and procedures for a variety of operations that will ensure successful manipulation of the forest and help achieve the planning goals. Best forest management practices are given in Chapter 6.

Forest Management Goals

Goals serve to establish the several purposes behind all management actions. Forest goals establish the direction in which a forest's composition and condition is to change. The goals of this forest plan are formulated in response to each of the identified forest management concerns (Chapter 2). All the ensuing management policy of this plan is intended to meet these goals, giving equal emphasis to each.

In fundamental terms, the eight goals are as follows:

- o Perpetuate forest stands that serve as important windbreaks, soil stabilizers, and prominent visual components of the Presidio.
- o Preserve stands and individual trees of high aesthetic or historic value.
- o Reduce predictable hazard conditions that may affect human safety or real property.
- o Preserve and restore areas supporting native plant communities and wildlife habitat.

- o Establish a diversity of forest stand ages to facilitate a steady maintenance program and promote a variety of wildlife uses.
- o Increase diversity of tree species to improve visual quality and resistance to insects and diseases.
- o Restore prominent vistas of San Francisco Bay, the Golden Gate Bridge, and the Pacific Ocean to public viewing areas.
- o Protect the forest from degradation due to mechanical injury, disease, insects, soil erosion, and wind.

Forest Management Guiding Policies

Guiding policies establish in general terms the management policies that should result in the forest management goals being met. In the next two chapters, these guiding policies are translated into implementation policies, practices, and objectives. However, whenever questions arise during site-specific implementation of the management direction of Chapters 5 and 6, the overall management intent as articulated in this section should govern the implementation.

Land Use Considerations

Because the Presidio is an active U. S. Army installation with a diversity of missions and activities, forest management should create a functional environment for these uses by implementing the following steps:

- o Integrate planning for forest and open space areas with the Presidio Master Plan. Consider compatibility with objectives of the City and County of San Francisco and GGNRA master plans.
- o Use plantings to visually separate incompatible land uses, define prominent public view corridors, and enhance the spatial quality of unique resources.
- o Protect human-use areas from harsh climatic conditions, particularly strong winds and blowing sand.

Vegetation Resources

Native Vegetation. Because the remnant pockets of native vegetation at the Presidio are among the few remaining in San Francisco County, and several sensitive plant

species are found only here, forest management should preserve and enhance these resources.

- o Restore or enhance natural vegetation that occurs or formerly occurred on the Presidio, where appropriate.
- o Introduce no invasive plant species that do not currently occur on the Presidio.
- o Maintain or enhance the habitat of known populations of sensitive plant species.
- o Control soil erosion and promote soil stability through the establishment and growth of natural vegetation.

Introduced Vegetation. Because most of the planted tree stands are not native and are beginning to decline because of age, the Presidio's forest should be carefully nurtured and gradually regenerated.

- o Promote the use of trees appropriate for the San Francisco climate, ideally species native to the central California coast.
- o Continue to rely on introduced tree species where site conditions are too harsh for native trees.
- o Promote forest, grassland, and shrub habitats in appropriate locations.
- o Promote the use of plant species with high wildlife values.

Wildlife Resources

Because the Presidio is one of the few areas within San Francisco County with sufficient undeveloped habitat to support a relatively large number of animal species, a key site for resident and migratory wildlife, and an important educational resource, forest management should protect wildlife values and biological communities.

- o Restore or enhance natural habitats that occur or formerly occurred at the Presidio to increase or promote the reestablishment of native wildlife species.
- o Maintain adequate habitat to provide required resources for naturally occurring wintering, migratory, breeding, or resident wildlife species.
- o Create an uneven-aged forest featuring several stages of habitat succession. In appropriate areas, retain fallen trees and selected older trees to become snags which are important habitat elements for several wildlife species.
- o Create a mosaic of large forest stands for interior dwelling species, grasslands and shrub habitats for species requiring open habitats, and edges among all three general habitat types for species found primarily in ecotones.

- o Create forests with a diverse structure, including areas with and without forest understory, and with open and closed canopy.
- o Provide and protect habitats for endangered wildlife species.
- o Enhance and enlarge as feasible the riparian and mixed evergreen forest habitats along Lobos Creek, around Mountain Lake, and at El Polin Spring.

Visual Resources

Because the Presidio is a nationally recognized scenic resource and an important open space area within densely-populated urbanized environment, forest management should maintain the Presidio's character of forested hills interspersed with historic structures with internal scenic vistas of the bay and ocean.

- o Maintain the Presidio's overall forest mosaic while conducting forest revegetation or habitat enhancement. Keep clearings small and utilize natural shapes conforming to landforms.
- o Retain to the extent feasible individual trees and stands of trees of high aesthetic value.
- o Vegetation management activities should be carefully selected to avoid detracting from the following viewpoints:
 - distant views looking toward the Presidio;
 - distant views looking outward from the Presidio toward the Golden Gate Bridge, the Palace of Fine Arts, the Pacific Ocean, and the San Francisco Bay;
 - nearby views of the Presidio from surrounding neighborhoods, beaches, and streets;
 - views from major roadways traversing the Presidio; and
 - interior views from the Presidio's neighborhoods and activity centers.

Recreational Resources

Because the Presidio is a heavily used recreational resource located adjacent to the GGNRA, forest management should maintain a scenic, vegetated background for recreational activities.

- o Manage forest stands to provide for open spaces and vistas in areas of high recreational use.
- o Provide recreational opportunities for residents and public visitors.

- o Provide interpretive services for both the natural and cultural environments of the Presidio, primarily through signs along trails and roads and natural history programs presented to interested organizations.
- o Consider appropriate vegetation management in areas adjacent to sports fields, tennis courts, and the golf course.

Cultural Resources

Because the Presidio has been occupied by Native Americans and Old World settlers, forest management should promote the conservation of cultural resources.

- o Increase the use of vegetation to buffer or screen intrusive, nonhistoric elements.
- o Prevent damage to archeological and historical properties and implement site-specific measures for resource preservation.
- o Maintain or restore appropriate landscaping for historical structures to assist in the interpretation of historical resources and values.
- o Recognize and maintain forest stands that are contributing elements of the Presidio National Historic Landmark and National Register District.

Chapter 5. Emphasis Area Policies and Objectives

Management Emphasis Areas

To implement the goals and guiding policies of this forest plan, each portion of the Presidio is allocated to a management emphasis area. The emphasis areas reflect each of the important issues facing management of the Presidio forest (Chapter 2). They include:

- o regeneration of windbreaks,
- o preservation of historic plantings,
- o enlargement of remaining native vegetation,
- o management of visual screens,
- o protection of major vistas,
- o control of tree topping,
- o increase in diversity and habitat, and
- o maintenance of landscape trees and hazard reduction.

The eight emphasis areas, including several subareas needed to address some specific conditions, are defined in Table 5-1. The term "emphasis" is intended to mean that the primary management intent and committed use of an area is that specified, although additional uses can occur wherever they are compatible with the emphasized use. Policies to assure multiple use of Presidio lands wherever possible are described in the preceding chapter. This chapter focuses on management policy unique to different areas.

The distribution of the emphasis areas across the Presidio is shown in Figure 5-1. The process of determining this allocation is described in Appendix J. The land acreages involved in this allocation are given in Table 5-2, and actual tree stand acreages are shown in Table 5-3. Allocations should be revised or adjusted by the implementing forester as conditions change.

Emphasis Area Policies and Treatments

In this section, management policies that should govern activities in each emphasis area are defined, and the actual treatments to forest stands and open areas, as needed to implement these policies, are described in detail. Treatments should be carried out with the use of best forest management practices (Chapter 6). Because vegetation regeneration is required for much of the existing forest, the treatments focus on vegetation replacement. Treatments for the maintenance of existing vegetation are also described, however.

To assist the use of the policies and treatments presented in this section, the location of each emphasis area is described, the present management situation is characterized, the

Table 5-1. Management Emphases

-
1. Maintain, Enhance, Replace, or Restore Windbreak System
 - 1a. Windbreaks
 - 1b. Landscaped Windbreaks
 - 1c. Dune Stabilization Windbreaks
 2. Maintain or Enhance Historical Stands and Entryway Plantings
 - 2a. Original Windbreak Stands
 - 2b. Original Entryway Landscaping
 3. Maintain, Enhance, or Restore Native Vegetation
 - 3a. Riparian Communities
 - 3b. Mixed Evergreen Forest
 - 3c. Coastal Scrub and Prairie

(m) maintain (r) restore
 4. Maintain, Enhance, or Create Screens
 - 4a. Visual Screen
 - 4b. Visual Screen and Windbreak
 - 4c. Visual Screen, Windbreak, and Golf Ball Barrier
 5. Maintain, Enhance, or Restore Bay/Ocean Views from Public Vistapoints
 6. Control Vegetation Management by Adjacent Landowners
 7. Enhance Vegetation Diversity and Wildlife Habitat
 8. Eliminate Safety Hazards and Maintain or Enhance Landscaping
-

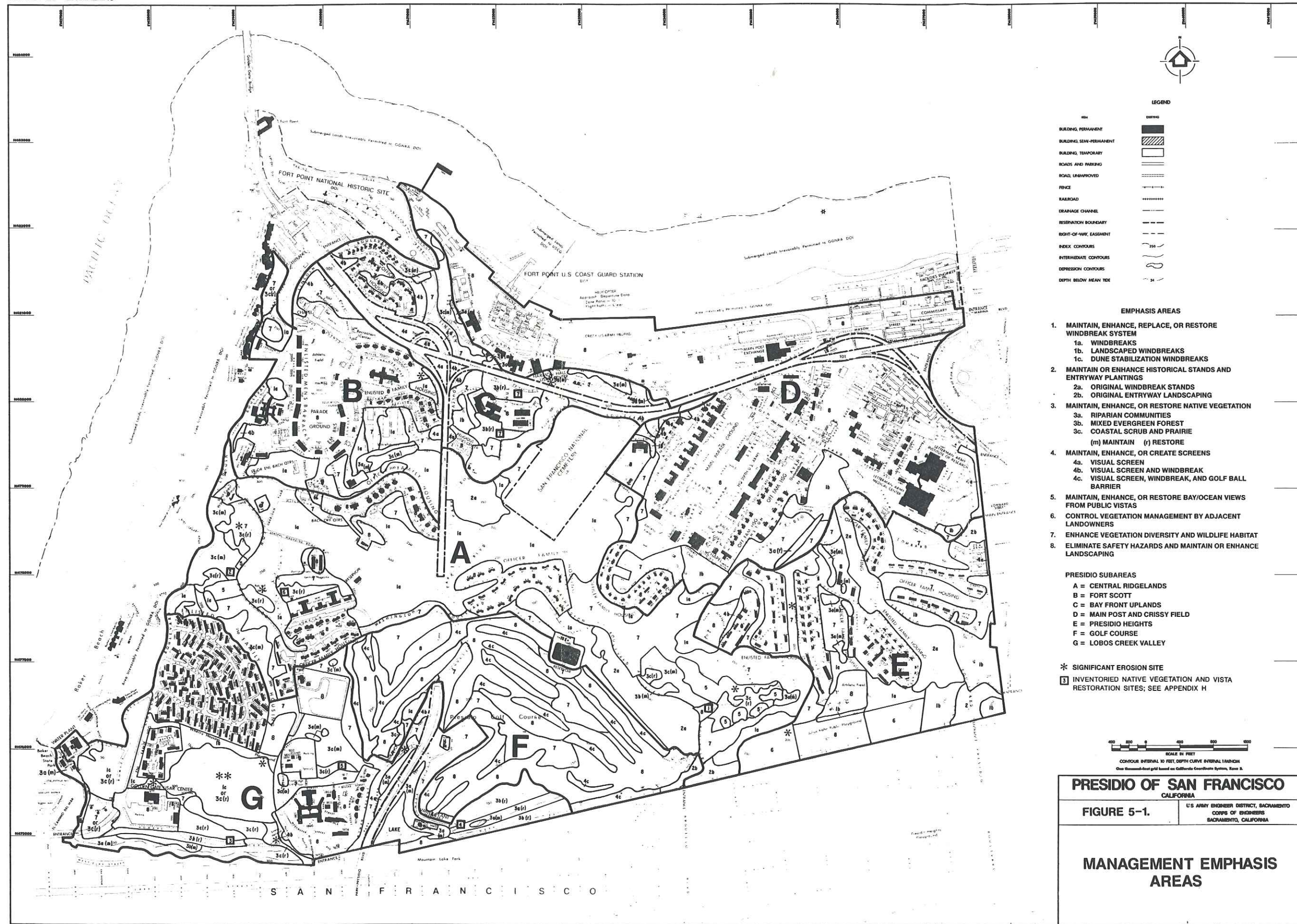


Table 5-3. Forest Stand Allocations to Emphasis Areas

Emphasis	Subareas* (acres)							Total Acres	% of Presidio Forest Stands	Approx % Presidio Forest Stands
	A	B	C	D	E	F	G			
Windbreaks										
1a. Windbreak	64.2	12.7	-	-	2.9	0.9	3.7	84.4	29.3	42
1b. Windbreak - Landscaped	-	-	4.5	3.6	8.7	-	-	16.8	5.8	
1c. Windbreak - Dune Stabilization	-	-	-	-	-	-	20.0	20.0	6.9	
Historical Plantings										
2a. Original Plantings - Windbreak	14.7	-	-	0.8	11.8	-	-	27.3	9.5	11
2b. Original Plantings - Entryway	1.1	-	-	-	1.8	0.6	-	3.5	1.2	
Native Vegetation										
3a. Native Vegetation - Riparian (m) Maintain	-	1.0	-	-	-	-	9.4	10.4	3.6	5 (m)
(r) Restore	-	-	-	-	-	-	1.7	1.7	0.6	
3b. Native Vegetation - Forest (m) Maintain	-	-	-	-	-	-	1.1	1.1	0.4	2 (r)
(r) Restore	-	-	0.3	-	-	-	4.3	4.6	1.6	
3c. Native Vegetation - Scrub and Prairie (m) Maintain	0.7	0.5	-	-	-	-	-	1.2	0.4	
(r) Restore	0.3	-	-	-	-	-	-	0.3	0.1	
Screens										
4a. Screen	-	0.4	1.5	-	-	-	0.6	2.5	0.9	9
4b. Screen - with Windbreak	-	1.5	3.1	0.3	0.7	-	0.2	5.8	2.0	
4c. Screen - with Windbreak and Ball Barrier	-	-	-	-	-	16.7	-	16.7	5.8	
5. View Enhancement	4.7	-	-	-	-	-	-	4.7	1.6	2
6. Control Tree Topping	-	-	-	-	7.3	-	-	7.3	2.5	2
7. Diversity & Habitat	27.8	4.8	5.8	5.4	2.7	16.7	9.6	72.8	25.2	25
8. Hazards & Landscaping	1.7	0.9	-	1.2	1.3	0.1	2.1	7.3	2.5	2
Total	115.2	21.8	15.2	11.3	37.2	35.0	52.7	288.4		

* Subareas are shown in Figure 5-1.

- A = Central Ridgeland
- B = Fort Scott
- C = Bay Front Uplands
- D = Main Post and Crissy Field
- E = Presidio Heights
- F = Golf Course
- G = Lobos Creek Valley

overall purpose of management of the emphasis area is succinctly stated, the policies and treatments are given, and the appropriate timing of implementation is noted.

Emphasis Area 1: Windbreaks

Location. Windbreaks are distributed along all ridgetops and to the west of high-use areas as shown in Figure 5-1. Stands in this emphasis area are listed in Appendix I and shown in Figure 5-1.

Management Situation. These stands were located and designed to block or dissipate wind energies from areas at the Presidio where people work or live. Three types of windbreaks were developed through the years: the original windbreaks consisting of untended forests, landscaped windbreaks in high-use areas where a tree and lawn appearance became desirable, and windbreaks designed to help stabilize shifting sands close to the coast.

The windbreaks are more than 100 years old, and many need to be replaced. Since very little reproduction has occurred in these stands, the windbreak function will not persist through the next two decades if action is not taken. Most of these trees have exceeded their typical lifespans, and one half show low vigor. Mortality and breakage is increasing, and trees bordering high-use areas have become potential hazards to life and property.

Emphasis Area Purpose. Within these areas, emphasis shall be given to maintaining, enhancing, replacing, or restoring the windbreak system.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Perpetuate remaining windbreaks of the original forest through a program of scheduled small-opening regeneration cuttings and reforestation within low-vigor stands.
- o Distinguish between landscaped and untended windbreaks; use maintenance practices that facilitate natural regeneration in untended stands and fuel treatment in landscaped stands.
- o For dune sand stabilization, use drought- and wind-resistant species that allow substantial understory cover. Arrest significant water erosion, especially erosion threatening viability of forest stands. Apply erosion control measures during regeneration.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Cutting Methods. The group selection cutting method should be used to regenerate these stands. This approach involves creation of a sequence of small clearings within each stand in a systematic spatial and temporal pattern. Clearings should be large enough to allow enough light to reach the ground for adequate seedling survival and growth. Clearings should be small enough to prevent wind damage or major visual impact. Accordingly, the typical dimension of such openings should be twice the height of the tallest trees on the south and east edges of the clearings. At the Presidio, the average height of

mature windbreak trees is approximately 75 feet. An opening 150 feet wide or about 0.5 acre in size should therefore be typically employed.

Openings should be distributed as evenly as possible throughout the forest's low-vigor stands (Appendices D and I). Wherever possible, adjacent openings should share no more than 15-percent common edge, and should be laid out so as to leave logical, appropriately sized future-cut groups between them. The procedures for laying out regeneration areas is described in "Stand Cutting Practices" in Chapter 6.

Revegetation. In most windbreaks, the same species that are removed should be replanted. Other noninvasive species should be planted where site conditions are appropriate, but, in general, species that have demonstrated their ability to grow and reproduce on a specific site should be used to revegetate it. Thus, blue gum eucalyptus, Monterey cypress, and Monterey pine should be the major species used since they have proven their ability to provide a functioning forest windbreak over the next century. Secondary species should be used whenever possible, however. Table 5-4 identifies appropriate windbreak revegetation species and is applicable to screens (Emphasis Area 4) as well.

Trees should be replanted at 10-foot intervals or at a rate of about 430 trees per acre for all species. Planting rates should be increased where sites are harsh.

In dune stabilization windbreaks (Emphasis Area 1c), drought-resistant tree species that do not form closed canopies but that reach relatively tall heights should supplement the current Monterey cypress and pines. Such species include Bishop pine and shore pine. These trees should be planted with a 15-foot spacing or at a rate of about 200 trees per acre to allow more light to reach the floor of the mature forest. Native low-growing scrub/strand species should be seeded or propagated by cuttings.

Site Protection. In the dune stabilization windbreaks (1c) where slopes exceed 15 percent, grass seeding with a punched straw mulch or other substantial erosion control treatment should accompany tree and ground cover planting. Signs, fencing, access route development, or other protective devices should be installed to curtail encroachment by vehicles and discourage pedestrians from walking through these stands. Drainage from roadways or areas outside of forest stands should be directed away from these stands. Access routes allowing repeated entry for watering and weeding maintenance should be established.

Revegetation Maintenance. Seedling weeding and watering should be done for 3 years. Tree thinning and weeding should be done approximately 7 years after planting.

Maintenance of Existing Vegetation. Present maintenance practices should generally be continued. Unlandscaped windbreaks (1a) should not be mowed, and natural tree regeneration (seedling growth) should be encouraged.

In landscaped windbreaks (1b), sanitation cuts to remove dead or dying trees should be made periodically. Fire hazard reduction through debris removal and mowing should be emphasized. However, damage to tree boles from mowers, which increases instances of butt rot, should be prevented. Mowing grasses up to the tree boles should not be practiced.

**Table 5-4. Tree Species Potentially Suitable to Supplement
Current Species in Various Emphasis Areas**

Common Name	Scientific Name	Emphasis Area ^a				
		1	4	6	7	8
Native Species						
California buckeye	<i>Aesculus californica</i>			*	*	
San Lucia fir	<i>Abies bracteata</i> ^b	*	*			*
Grand fir	<i>Abies grandis</i> ^b		*			
Madrone	<i>Arbutus menziesii</i> ^b			*	*	
Incense cedar	<i>Calocedrus decurrens</i> ^b		*			*
Port Orford cedar	<i>Chamaecyparis lawsoniana</i> ^b		*			*
Pygmy cypress	<i>Cupressus pygmaea</i>	*	*			*
Gowen cypress	<i>Cupressus goveneana</i>	*		*		
Sargent cypress	<i>Cupressus sargentii</i>	*		*		*
Toyon	<i>Heteromeles arbutifolia</i>		*	*	*	*
Tanbark oak	<i>Lithocarpus densiflora</i> ^b		*	*	*	
Catalina ironwood	<i>Lyonothamnus floribundus</i> ^b	*	*			*
Coulter pine	<i>Pinus coulteri</i>	*	*			
Shore pine	<i>Pinus contorta</i> ^b	*		*		
Bishop pine	<i>Pinus muricata</i>	*	*	*		*
Ponderosa pine	<i>Pinus ponderosa</i> ^c	*				
Torrey pine	<i>Pinus torreyana</i>	*	*			*
Knobcone-Monterey Pine	<i>Pinus x attenuuradiata</i>	*	*			
Holly leaf cherry	<i>Prunus ilicifolia</i>		*	*	*	
Douglas-fir	<i>Pseudotsuga menziesii</i> ^{b,c}	*	*			
Coast live oak	<i>Quercus agrifolia</i>	*	*	*	*	*
Canyon oak	<i>Quercus chrysolepis</i>	*		*	*	*
Scrub oak	<i>Quercus shrevei</i>			*	*	
Willow	<i>Salix spp.</i> ^b		*	*		
Redwood	<i>Sequoia sempervirens</i> ^{b,c}		*			*
California nutmeg	<i>Torreya californica</i> ^b		*	*	*	
California bay	<i>Umbellularia californica</i> ^b	*	*	*	*	*
Non-Native Species						
Deodar cedar	<i>Cedrus deodora</i>	*	*			*
Beefwood	<i>Casuarina stricta</i>	*				
Australian pine	<i>Casuarina glauca</i>	*				
Mexican cypress	<i>Cupressus benthamii</i>	*	*			
Bhutan cypress	<i>Cupressus torulosa</i>	*	*			
Manna gum	<i>Eucalyptus viminalis</i>	*				

Table 5-4. Continued

Common Name	Scientific Name	Emphasis Area ^a				
		1	4	6	7	8
Kangaroo Island gum	<i>Eucalyptus cneorifolia</i>	*	*			
Murray red gum	<i>Eucalyptus camaldulensis</i>	*	*			
Pinaster pine	<i>Pinus pinaster</i>	*				
Italian stone pine	<i>Pinus pinea</i>	*		*		*
Emondi pine	<i>Pinus roxburghii</i>	*	*			*
Brutia pine	<i>Pinus halepensis</i>	*	*			

^a Emphasis Area 1: windbreaks.

Emphasis Area 4: screens.

Emphasis Area 6: low-stature trees.

Emphasis Area 7: wildlife food sources.

Emphasis Area 8: landscaping trees.

^b Not as drought tolerant as other species; requires increased watering frequency.

^c Seeds should be obtained from coastal subspecies south of San Francisco.

Timing. Since an estimated 50 percent of the windbreak stands (those currently having low vigor) will not survive beyond the next 20 years, the treatment should begin as soon as possible. Only at mature height will trees provide the windbreak function.

In dune stabilization windbreaks (1c), recommended access control and drainage improvements should be initiated as soon as possible.

Emphasis Area 2: Historical Plantings

Location. These stands are located adjacent to roads in three highly visible locations. Stands in this emphasis area are listed in Appendix I and shown in Figure 3-3.

Management Situation. The historical plantings are symbols of military pride and orderliness. Although these stands were also intended to be part of the windbreak system, they have been kept evenly spaced, well mowed, and carefully maintained. Many are old and in declining health, along with much of the rest of the windbreak system, but these particular stands have high historical and aesthetic value. Reforestation of these stands with young trees would disrupt their visual character.

Emphasis Area Purpose. Within these areas, emphasis should be given to maintaining or enhancing original stands and entryway plantings as long as practicable.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o In particular stands of identified significant historical value, maximize vigor of stands and individual trees as long as safely possible through sanitation cutting, weeding, and soil treatment.
- o Eventually replace groups of trees when openings visually dominate stands, and treat as landscaped windbreaks thereafter.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Maintenance of Existing Vegetation. The prescribed treatment is to delay regeneration as long as possible by performing the intensive stand improvement measures listed below to improve the health of the trees. These practices should continue until 40 percent of the trees that were present during the 1984 inventory have died or been removed. It is expected that these stands can survive with this additional care through the 1990s. When more than 40 percent of the trees in a visually distinct area have died or been removed, regeneration will begin as described above for the landscaped windbreaks (1b), and these stands should be managed as such thereafter.

Exceptions are the eucalyptus stands, which are relatively vigorous and able to sprout from their roots when cut. Sprouts from trimmed tree roots can be selectively controlled to provide replacements for the removed trees at the original sites. Although the visual appearance of the stands will be altered, the orderly appearance of the historic stand would largely be retained. These stands would not have to be eventually converted to landscaped windbreaks (1c).

The process of extending the life of these stands beyond their normal lifespan will require constant, careful monitoring and prompt removal of diseased, insect-infested, or severely damaged trees. Other techniques to improve the vigor of these stands should include deep watering (especially during dry springs), soil tilling, fertilization, and pruning.

Site Protection. These historical stands should be provided some protection from inadvertent human damage by posting historical interpretive signs at points of likely pedestrian entrance.

Revegetation. When gateway plantings (Emphasis Area 2b) deteriorate substantially and require rehabilitation or replacement, a site-specific revegetation plan that appropriately replicates the historical planting should be prepared by a qualified landscape architect.

Timing. The current stands have a sufficient number of trees to retain the desired forest appearance. For the next 10 years, only a few regeneration plantings will need to be located in this emphasis area. After 10 years, many of these areas will probably have to be regenerated as part of the landscaped windbreak emphasis (1b).

Emphasis Area 3: Native Vegetation

Location. Remnant native vegetation communities are primarily located in the southern and western portions of the Presidio, as shown in Figure 2-1. Recommended restoration sites of this plan, with one exception, are in or adjacent to these remnants. Remnants to be maintained and the areas suitable for restoration are shown in Figure 5-1 ("m" and "r" variants of Emphasis Area 3). In addition, the locations of the seven recommended restoration sites described in Appendix H are also shown in Figure 5-1.

Management Situation. As described in Chapter 3, remnants of several native coastal vegetation communities are present on the Presidio (Figure 2-1). These communities have survived in areas not committed to developed uses or planted to forest. Thus, their presence today results from fortuitous circumstance rather than active management.

At present, these native vegetation communities are not actively maintained or protected by the Presidio staff. In fact, some of the communities have been degraded by base operations as well as through the uncontrolled actions of individuals. In addition, several of these communities are being degraded severely by invasive introduced plants. In particular, German ivy, iceplant, broom, and, occasionally, eucalyptus are invading these communities and are expected to continue their expansion in the absence of countermeasures.

The perceived value of these remnant native plant communities has been increasing in recent years as they gradually diminish in size and viability throughout the coastal regions of California. Fortunately, the coastal scrub and strand communities over most of the Presidio's ocean bluffs are now actively managed for preservation by the NPS. The remainder of the Presidio (the plan area) also supports some of the more inland communities such as coastal prairie, coastal riparian, and mixed evergreen forest that are absent from the immediate shoreline and bluff area of the NPS.

Emphasis Area Purpose. Within these areas, emphasis should be given to maintaining, enhancing, or restoring occurrences of native vegetation.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Maintain viability of all remaining areas of native vegetation by controlling invasive, non-native vegetation and maintaining suitable hydrologic conditions.
- o Restore native vegetation to identified sites near existing native vegetation communities to promote community viability and create a network of native habitats. Remove forest stands for this purpose only where view enhancement goals (see below) would be met or native riparian habitats would be enhanced. Allow restoration by qualified volunteer groups based on appropriate plans where government resources are inadequate.
- o Protect existing and restored native vegetation from invasive species by planting buffer strips with native tree species of the mixed evergreen forest.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Maintenance of Existing Vegetation. Maintenance should involve two primary actions: preventing damage from human activities and reducing competition from introduced invasive species. Damage prevention measures should include:

- o posting natural history interpretive signs at each native vegetation site to describe the communities present and to illuminate the need for protection,
- o installing post and cable barriers to vehicles where evidence of such intrusion is apparent,
- o installing designated walkways where pedestrian traffic is degrading vegetation,
- o removing facilities built within these communities when facility reconstruction or replacement is needed, and
- o preventing the concentration of drainage for offsite areas through the sites.

Invasive vegetation should be controlled by:

- o cutting back encroaching tree stands or pruning low branches on trees within the communities, since the native communities are generally favored by full sunlight;
- o grubbing out the invasive understory species on a repeated basis when sufficient base personnel or volunteer manpower can be assembled;

- o removing invasive species having a spreading branch form (e.g., iceplant and ivy) with a mechanical ripper, where native species would be expected to reassert site dominance through seed growth; and
- o applying herbicides where rare plant populations will not be adversely affected.

Restoration of Native Vegetation. Vegetation restoration at seven recommended sites should be done in accordance with site-specific guidelines presented in Appendix H. A detailed restoration plan reflecting these guidelines should be prepared for each site during the season prior to the anticipated work. Each plan should be reviewed by GGNRA staff and the local chapter of the California Native Plant Society prior to implementation.

Two of the restoration projects (at Inspiration Point and the Rob Hill Bluffs) should be done in connection with enhancement of the historical views described under Emphasis 5 below.

Timing. While initiation of treatments is not as urgent as windbreak regeneration and hazard tree removal, the remnant native vegetation will incur significant losses in the next decade if control of invasive vegetation and human degradation is not instituted shortly.

Emphasis Area 4: Screens

Location. Existing screens are in several high-use areas, including within the Main Post and Fort Scott areas near the Golden Gate Bridge access freeways, the golf course, and several other areas. New screens are needed at the golf course, along the eastern Presidio boundary, and near the old hospital above Lobos Creek. Stands comprising the existing screens are listed in Appendix I and shown in Figure 3-3. The location of these screens and recommended new screens are shown in Figure 5-1.

Management Situation. The functions of screens on the Presidio are to obscure views of nonhistoric, unaesthetic structures and facilities, provide landscaping, and buffer highway noise and glare from residents and other users of the base.

Screens may be categorized into three groups. The first group affords only visual screening with the use of low trees and shrubs. The second group provides both visual screening and a windbreak and is composed of both tall trees and the eye-level vegetation of the first group. The screens of the third category are similar to, but denser than those of the second group; and are used on the golf course where players, buildings, and adjacent homes must be protected from damage by errant golf balls. The latter screens also serve as windbreaks and visually define the fairways.

Several screens are in need of immediate tree replacement, although the average health of the screens, especially the golf course screens, is better than that of the Presidio forest as a whole. The majority of the screens do not need replacement during the planning period. Their superior health results from lack of competition with other vegetation for water and light, younger age (most were planted substantially later than the main forest), and the provision of regular landscaping maintenance.

Emphasis Area Purpose. Within these areas, emphasis should be given to maintaining, enhancing, or creating screens, including visual screens (1a), windbreak visual screens (1b), and windbreak golfing barriers (1c).

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Maintain and improve visual screening of nonhistoric structures and facilities from federal and state highways and perimeter city streets and properties. To create screens, coppice eucalyptus or plant shrubs and trees having high canopy density and tolerance for site and stand conditions.
- o Distinguish between screens needed only for visual screening and those that also serve a windbreak function.
- o Maintain golf course stands in a manner that will provide visual containment and a windbreak, prevent damage from errant golf balls, and minimize litterfall on fairways where possible.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Revegetation. Two approaches are needed to replace screens. The first approach is to immediately replace shrubs and trees that have failed, and the second is to underplant the older, low-vigor screens on a scheduled basis.

Each screen shrub or tree that fails should be replaced immediately. Replacement shrubs and trees should be a combination of 1-gallon container stock (for immediate results) and bare-root stock (for a long-term screen). At least three replacements should be planted for each individual plant lost. Replacement species should be the same as the failed species where the loss is to a screen composed of several individuals of the same species. Where screens are composed of several species, desirable replacements include evergreen species appropriate to site conditions (Tables 5-4 and 5-5). Species were included within these tables if they were determined to be appropriate for landscaped and maintained areas; do well in the climate zone and micro climate of the Presidio; have no serious propensities for defects or disease; are noninvasive in the Bay area; and provide positive aesthetic features, such as refined evergreen habitat or showing fruit, flowers, or full color. Some screens can be regenerated by coppicing of eucalyptus, as described under "Creating New Screens" below.

The long-term approach to screen regeneration is to underplant the existing screens and remove the overmature screen trees when the understory is established. Bare-root stock should be used for underplanting, and average spacings should be 8-10 feet. Species described for replacement planting should be employed. Because screens are often narrow, light reaching these shrubs and trees should be sufficient for their growth. In cases where light is insufficient, limited pruning of the existing screen should be done. Underplanting also allows for experimentation and the possibility of species failure without serious loss of the screening function.

Table 5-5. Shrubs and Small Trees for Landscaping at the Presidio

Common Name	Scientific Name	Comments*
Species Native to Coastal Bay Area		
California buckeye	<i>Aesculus californica</i>	dec, flrs, frt, drt
Madrone	<i>Arbutus menziesii</i>	ev, flrs
Giant chinquapin	<i>Castanopsis chrysophylla</i>	ev, frt, drt
California lilac	<i>Ceanothus thyrsiflorus</i> <i>griseus</i> var. <i>arboreus</i>	ev, flrs
Ceanothus	<i>Ceanothus</i> spp.	ev, dec, flrs
Western redbud	<i>Cercis occidentalis</i>	dec, flrs, frt, fall
Mountain mahogany	<i>Cercocarpus betuloides</i>	ev, flrs, frt
Coast silktassel	<i>Garrya elliptica</i>	ev, flrs, drt
Toyon	<i>Heteromeles arbutifolia</i>	ev, flrs, frt, drt
Tanoak	<i>Lithocarpus densiflorus</i>	ev
Silver lupine	<i>Lupinus albifrons</i>	ev, flrs, drt
Tree lupine	<i>Lupinus arboreus</i>	ev, flrs, drt
California holly grape	<i>Mahonia pinnata</i>	ev, flrs, drt
Pacific wax myrtle	<i>Myrica californica</i>	ev
Osoberry	<i>Osmaronia cersiformis</i>	dec, flrs
Bitter cherry	<i>Prunus emarginata</i>	dec, fall, flrs
Hollyleaf cherry	<i>Prunus illicifolia</i>	ev, flrs, drt
Western choke cherry	<i>Prunus virginiana</i> var. <i>demissa</i>	dec, fall, flrs
California coffeeberry	<i>Rhamnus californica</i>	ev, frt, drt
Redberry	<i>Rhamnus crocea</i>	ev, frt, drt
Golden currant	<i>Ribes aureum</i>	dec, flrs, frt
Red flowering gooseberry	<i>Ribes sanguineum</i>	dec, flrs, frt
Willow	<i>Salix</i> spp.	dec

Species Native to Other California Regions

Summer holly	<i>Comarostaphylis diversifolia</i>	ev, flrs, frt
Island bush poppy	<i>Dendromecon harfordii</i>	ev, flrs, drt
Flannel bush	<i>Fremontodendron</i> spp.	ev, flrs, drt
Catalina ironwood	<i>Lyonothmrus</i> spp.	ev, drt
Mahonia	<i>Mahonia amplexans</i>	ev, flrs, frt
Oregon grape	<i>Mahonia aquifolium</i>	ev, flrs, frt
Nevin mahonia	<i>Mahonia nevinii</i>	ev, flrs, frt
Yellow penstemon	<i>Penstemon antirrhinoides</i>	ev, flrs
Matilija poppy	<i>Romneya coulteri</i>	ev, flrs, drt
Lemonade berry	<i>Rhus integrifolia</i>	ev, frt, drt
Laurel sumac	<i>Rhus laurina</i>	ev, drt
Sugar bush	<i>Rhus ovata</i>	ev, flrs, drt

Table 5-5. Continued

Common Name	Scientific Name	Comments*
White sage	<i>Salvia apiana</i>	ev, flrs, drt
Viguiera	<i>Viguiera</i> spp.	ev, drt
Species Not Native to California		
Coastal wattle	<i>Acacia cyclops</i>	ev, flrs
Peppermint tree	<i>Agonis flexuosa</i>	ev
Strawberry tree	<i>Arbutus unedo</i>	ev, flrs, frt
Barberry	<i>Berberis</i> spp.	ev, flrs, frt, drt
Smoke tree	<i>Cotinus coggygia</i>	dec, flrs, fall, drt
Hopseed bush	<i>Dodonaea viscosa</i>	ev, frt, drt
Silverberry	<i>Elaeagnus pungens</i>	ev, drt
White escallonia	<i>Escallonia bifida</i>	ev, flrs
Escallonia	<i>Escallonia</i> spp.	ev, flrs
Pineapple guava	<i>Feijoa sellowiana</i>	ev, flrs, frt
Sea urchin	<i>Hakea laurina</i>	ev, drt
Sweet hakea (pincushion)	<i>Hakea suaveolens</i>	ev, drt
Italian jasmine	<i>Jasminum humile</i>	ev, flrs, frt
Juniper	<i>Juniperus</i> spp.	ev, drt
Bush lantana	<i>Lantana camara</i>	ev, flrs
Australian tea tree	<i>Leptospermum laevigatum</i>	ev, flrs, drt
Silver tree	<i>Leucadendron argenteum</i>	ev
Western tea myrtle	<i>Melaleuca nesophila</i>	ev
New Zealand Christmas tree	<i>Metrosideros excelsus</i>	ev
Compact myrtle	<i>Myrtus communis</i>	ev, flrs, frt
Sweet osmanthus	<i>Osmanthus fragrans</i>	ev, flrs
Oleander	<i>Nerium oleander</i>	ev, flrs, drt
Photinia	<i>Photinia fraseri</i>	ev, flrs
Chinese pistache	<i>Pistacia chinensis</i>	dec, frt, fall
Pittosporum	<i>Pittosporum eugeniodes</i>	ev
Victorian box	<i>Pittosporum undulatum</i>	ev
Cape plumbago	<i>Plumbago auriculata</i>	ev, flrs
Carolina cherry laurel	<i>Prunus caroliniana</i>	ev, flrs
Catalina cherry	<i>Prunus lyonii</i>	ev, flrs
India hawthorn	<i>Raphiolepis indica</i>	ev, flrs, frt
Italian buckthorn	<i>Rhamnus alaternus</i>	ev, drt
Fuchsia-flowered gooseberry	<i>Ribes speciosum</i>	ev, flrs, frt
Rosemary	<i>Rosmarinus officinalis</i>	ev, flrs
Pussy willow	<i>Salix discolor</i>	dec, flrs, fall
Rose-gold pussy willow	<i>Salix gracilistyla</i>	dec, flrs, fall

Table 5-5. Continued

Common Name	Scientific Name	Comments*
Purple osier willow	<i>Salix purpurea</i>	dec, flrs, fall
Australian bluebell	<i>Sollya heterophylla</i>	ev, flrs, drt
Cape honeysuckle	<i>Tecomaria capensis</i>	ev, flrs
Sweet viburnum	<i>Viburnum japonicum</i>	ev, flrs, frt
Sandankwa viburnum	<i>Viburnum suspensum</i>	ev, flrs, frt
Westringia	<i>Westringia rosmariniformis</i>	ev, flrs, drt
Shiny xylosma	<i>Xylosma congestum</i>	ev

*Definitions of comment abbreviations:

ev = evergreen.
 dec = deciduous.
 flrs = showy flowers.
 frt = showy fruit.
 fall = fall color.
 drt = drought tolerant.

Creating New Screens. New screens should be created in emphasis area 4 in Figure 5-1 where none exist today (e.g., along the Letterman General Hospital parking lot fronting the eastern Presidio border and west of the old hospital above Lobos Creek).

New low screens should be planted with evergreen shrubs, and windbreak screens should be planted with evergreen shrubs and windbreak trees, as appropriate for site conditions (Table 5-4). Alternatively, where blue gum eucalyptus is present, a screen of young eucalyptus saplings can be developed. When cut, eucalyptus sprouts vigorously from its root crown. These young plants are often attractive and can form dense screens if successive "coppicing" cuts are made regularly. Windbreak screens can be formed by coppicing some individuals and leaving others.

Timing. Screen trees that die should be replaced promptly, but a regeneration program should also be initiated in the immediate future. The recommended development of new screens should commence shortly.

Emphasis Area 5: View Enhancement

Location. The two ridgetop vantage points are near the summits of Inspiration Point and Rob Hill. A third vantage point, the Crissy Field overlook, is surrounded by coastal scrub, and the vista is not obscured or threatened. Stands in this emphasis area are listed in Appendix I and shown in Figure 3-3.

Management Situation. In the original afforestation plan for the Presidio, vantage points near the ridge summits were to rise above the forest on the slopes below. The upper slopes were left covered by the native low-growing coastal prairie, coastal scrub, or mixed evergreen forest communities. This scheme was intended to afford a completely uninterrupted view of the bay or ocean, even when the forest matured.

Since the early 1930s, trees have been either planted or have naturally expanded upslope into these designed open spaces. Views of the bay and ocean are appreciably blocked. A conversion to the original foreground vegetation at the vantage points would restore both the expansive views as well as the native plant communities.

Emphasis Area Purpose. Within these areas, emphasis should be given to maintaining, enhancing, and restoring bay and ocean views from the two ridgetop public vantage points.

Emphasis Area Policies. The following policies should be implemented through the treatments below.

- o Restore and maintain bay and ocean views at historic, currently designated scenic vistas (Inspiration Point, Rob Hill, and the Crissy Field overlook) by gradually eliminating wild, introduced stands and expanding native low-stature vegetation. Accomplish in conjunction with native vegetation restoration as described above.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

North and east of Inspiration Point a combination of mixed evergreen hardwood forest and coastal prairie should be reestablished (Figure 5-2). At the Rob Hill bluffs, expansion of the coastal scrub should be encouraged (Figure 5-3). Refer to Appendix H for guidelines on how to restore these particular native plant communities; those guidelines should be considered, together with the following stand-cutting treatments.

Encroaching forest stands should be removed in two steps to minimize the visual impact at these vantage points.

In the first step, view corridors should be developed using patch and strip cuts, removing about one half of the encroaching stands. These cuts should be laid out to facilitate the final step. Native low-stature vegetation should then be established in the cut areas through seeding and transplanting. Any non-native reinvasion vegetation should be removed as needed.

In the final step 5-10 years after the first, the remaining stands should be cut. Care should be taken in moving logs to access routes to minimize damage to native vegetation established following the earlier patch cuts. Again, native vegetation should be established into the cut areas as needed, and any non-native reinvasion vegetation should be removed.

Native hardwoods should be planted between the remaining introduced forest and the restored open space. These hardwood species grow only to relatively low heights and will not block the restored views, yet they will prevent the introduced forest species from expanding through seeding into the restored open spaces.

Timing. Considering substrate conditions and the vigor of the expanding stands, these vistas and the remnant native plant communities may be substantially lost within 20 years if action is not taken.

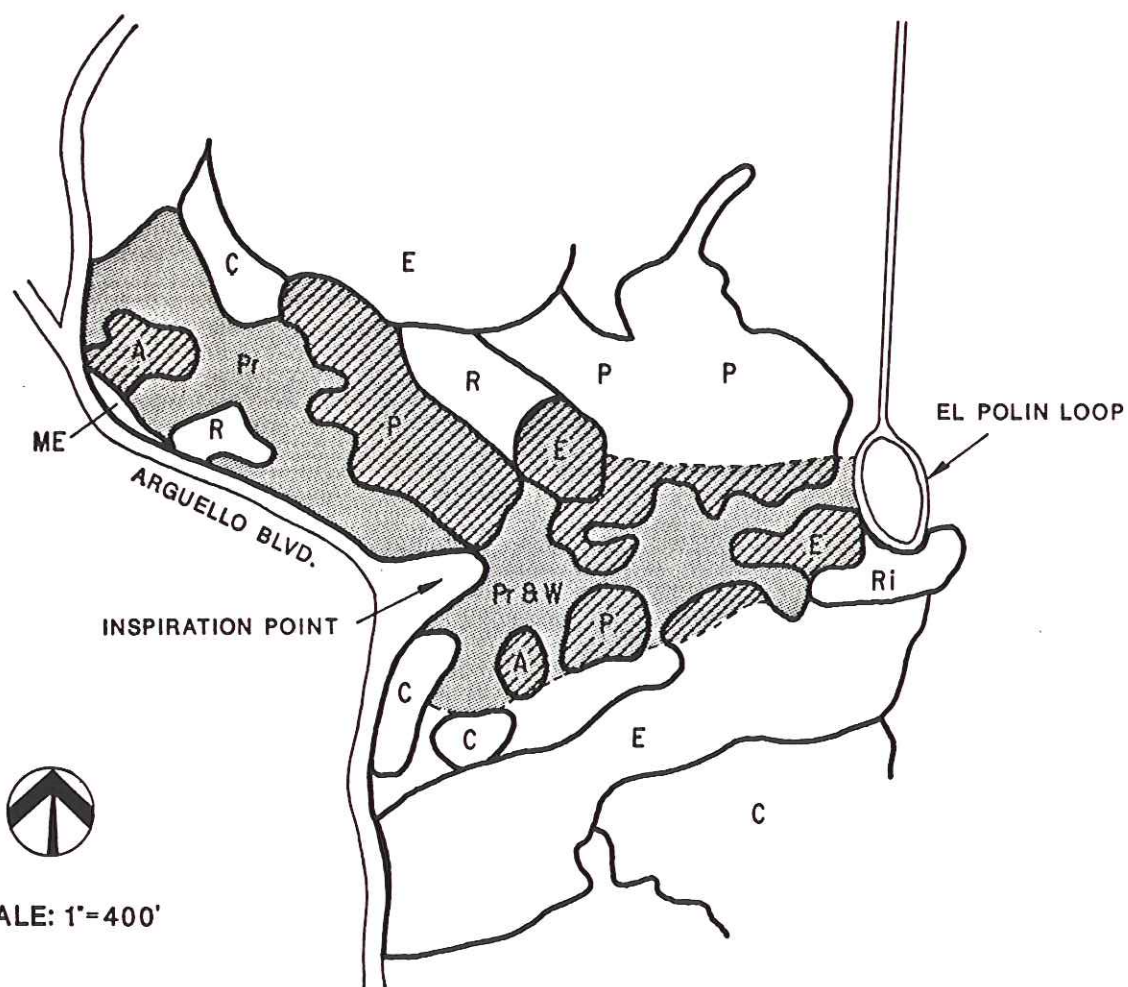
Emphasis Area 6: Control Tree Topping

Location. Stands 143 and 150 are along the southern Presidio boundary, as shown in Figures 3-3 and 5-1.

Management Situation. Historically, residents adjacent to the Presidio have been allowed to cut the tops of trees on Presidio property when tree growth begins to obscure their views of the bay and ocean. Maintenance of these views purportedly adds substantially to the value of these residences. The practice has been most persistent in Monterey cypress stands along Pacific Avenue west and east of Julius Kahn Park, since the topography affords expansive views, if not obscured by tree growth.

The prevalent topping height east of the park is uniformly about 30-35 feet. West of the park the topping has been less persistent and uniform, but topping heights of 50-60 feet appear more common. These stands are part of the original introduced forest and now show low vigor.

Tree topping has also been practiced at various times in other locations near the Presidio boundary, as well as at the designated vantage points. However, tree topping has been discontinued as a maintenance practice by Presidio personnel.



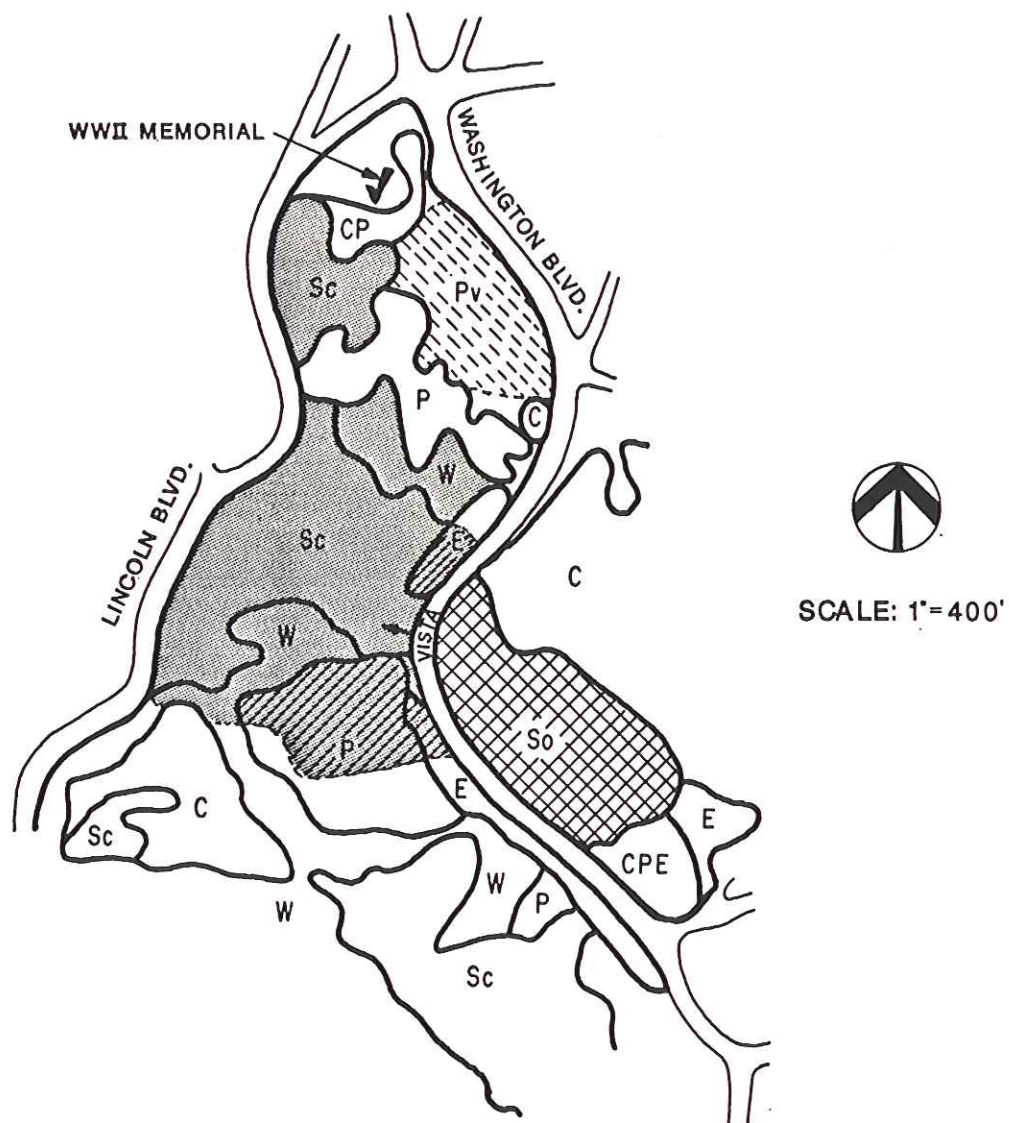
EXISTING VEGETATION

Pr NATIVE COASTAL PRAIRIE
W NON-NATIVE WEEDY SPECIES
Ri NATIVE RIPARIAN
E EUCALYPTUS
P MONTEREY PINE
C MONTEREY CYPRESS
A ACACIA
R REDWOOD
ME MIXED EVERGREENS

PLANNED ACTIONS

 REMOVE STANDS
 ENHANCE OR RESTORE NATIVE PRAIRIE VEGETATION

FIGURE 5-2. VISTA ENHANCEMENT AT INSPIRATION POINT



EXISTING VEGETATION

- Sc NATIVE COASTAL SCRUB
- W NON-NATIVE WEEDY SPECIES
- P MONTEREY PINE
- C MONTEREY CYPRESS
- E EUCALYPTUS

OTHER

- Pv PAVEMENT
- So EXPOSED SOIL AND MATERIALS STOCKPILES

PLANNED ACTIONS

-  REMOVE STANDS
-  ENHANCE OR RESTORE NATIVE SCRUB VEGETATION
-  CREATE AND PROTECT NATIVE LUPINE HABITAT
-  REMOVE PAVEMENT AND DEVELOP DIVERSITY OF TREES AND SHRUBS

FIGURE 5-3. VISTA ENHANCEMENT AT ROB HILL

Although trees can often respond to topping by growing laterally and eventually upward again, topping increases stress on the growing individuals, creates a structural weakness, and provides an opening for the entry of disease or insects. Given the cost to establish and maintain forest vegetation at the Presidio, tree topping imposes an unacceptable risk of significant, unnecessary costs and liabilities on the government.

Emphasis Area Purpose. Within these areas, emphasis should be given to controlling vegetation management by adjacent landowners and converting the affected area to lower-stature stands of native tree species.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Convert stands periodically being topped for the maintenance of views from adjacent properties along West Pacific Avenue to lower-stature trees adapted to the site conditions. Convert in successive strips from the interior to the perimeter. Until conversion is complete, allow continued tree topping on a fee basis, and use collected fees to fund the conversion.
- o After conversion is complete, do not use or allow tree topping in the Presidio forest, except in limited situations where it is the best forest management practice (Chapter 6) for treating hazardous landscaping trees.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Approach. The conversion should occur gradually, beginning on the north edge of the emphasis areas and advancing in five increments to the southern Presidio boundary. This approach will allow adjustments to revegetation procedures as warranted by performance and will minimize the visual impact of the conversion on neighboring residents.

When the conversion is complete, the emphasis area will be eliminated, and the area can become part of Emphasis 1b, "Landscaped Windbreak," Emphasis 8, "Diversity and Habitat," or Emphasis 3, "Native Vegetation," as determined by revision of the forest plan at that time.

Cutting Methods. Five strip cuts approximately 80 feet wide and 650 feet long should be used for each of the two stands. These will be 1.2-acre openings. To maximize available sunlight to the first strip, trees immediately adjacent to the strip should be pruned. Successive strip cuts should be made every 5 years so that the conversion is complete in 20 years.

Revegetation. Native evergreen hardwoods, including coast live oak, California bay laurel, and Pacific madrone, should be planted in the cut areas. These are low-stature species that attain heights of only 30-35 feet at maturity and will therefore not encroach upon the views being preserved. Although these native species can be difficult to grow, their performance is expected to be satisfactory. Coast live oak, in particular, is a climax species in the Monterey area on old sand dunes (Major and Johnson 1977), which comprise the substrate in this area (Figure 3-1). Non-native species should also be planted initially, to examine their potential for superior performance. Species such as Bishop pine, shore pine, Italian stone pine, and pygmy cypress should be used.

Trees should be planted with 10-foot spacings or at a rate of about 430 seedlings per acre.

Funding. This species conversion project should be funded by the neighbors who request permission to top trees. One funding mechanism is a tree-topping fee, imposed when permission is granted for tree topping during the plan period. Based on an estimated annual net cost of \$4,563 for the conversion and on the total number of trees subject to topping in this emphasis area (333 trees over 20 years, or roughly 17 trees per year), a minimum fee of \$275 per tree topping should be assessed and placed in a conversion fund. Thus, requests made within the next 20 years to top existing trees in the emphasis area should be assessed a fee. Once the funding is complete, no further tree topping should be allowed.

Alternatively, the U. S. Corps of Engineers could enter into an agreement with a neighborhood homeowners' association to permit tree topping in exchange for a donation of services, including debris removal, site preparation, and tree planting and maintenance, directed toward meeting the vegetation management objectives of this plan.

Timing. Because the stands of this emphasis area exhibit low vigor, the species conversion treatment should be initiated shortly.

Emphasis Area 7: Diversity and Habitat

Location. These areas are located throughout the forest and are residual to the other management emphasis areas. Emphasis Area 7 includes both forest stands (shown in Appendix I) and open spaces not supporting native species. A comparison of acreages in Tables 5-2 and 5-3 appears to indicate the existence of a relatively large nonforest area; however, much of this nonforest acreage is roadway.

Management Situation. Although the Presidio forest provides some of the only remaining wildlife habitat in San Francisco County the diversity of forest species is not particularly high. Diversity of tree age within introduced stands is usually low. For the most part, the Presidio forest is composed of introduced tree monocultures rather than diverse forest ecosystems. Areas of the Presidio forest not committed to the satisfaction of other needs (other emphasis areas) provide opportunities to implement a transition toward forest ecosystems.

Emphasis Area Purpose. Within this area, emphasis should be given to creating forest ecosystems with enhanced vegetation diversity and wildlife habitat.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Facilitate the transition of monotypic stands to forest ecosystems containing complex stand structures, increased plant species diversity, and higher wildlife values.
- o Allow stand decadence where persons or property are not endangered; permit the presence of down, woody material; and encourage natural regeneration of trees and shrubs.

- o As individual trees or groups fail, create small openings and complex vegetation structures through varied cutting patterns and replantings.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Maintenance of Existing Vegetation. As described in Chapter 3, most trees on the Presidio are relatively old, and approximately 50 percent are expected to become senescent and die within the plan period if not nurtured or cut. In Emphasis Area 7, trees should be allowed to die before being replaced, since they are not crucial to the windbreak function or base landscaping and are not in hazardous locations. Moreover, snags and dead and down woody material should be left undisturbed in this emphasis area insofar that resulting fuel loads do not create unacceptable risks of wildfire.

Except for highly invasive species, natural regeneration of trees, shrubs, and other native and introduced understory plants should be allowed throughout this emphasis area.

Cutting Methods. Where openings begin to develop naturally through tree mortality, they should be evaluated to determine which plant species or combination of species will maximize the area's wildlife habitat value. Revegetation prescriptions should be based on the objective of developing a complex mosaic of small openings and small groups diverse vegetation types.

The proposed cutting method is a variation on the group selection method. Areas to be cut are centered on openings developing around dead or dying trees. Openings generally should be the same size as described for windbreaks (0.5 acre), although smaller openings should be used where the specific site affords adequate sunlight. To ensure adequate sunlight for regeneration, it is appropriate to enlarge the developing opening by cutting adjacent trees that have not yet failed.

Revegetation. Although the majority of the tree and shrub species planted should be native to the California coast, other trees and shrubs of high value to wildlife should also be planted. Appropriate tree species include the three California live oaks (coast, interior, and canyon), bay laurel, madrone, and other species appropriate to site conditions (Table 5-4). Appropriate shrub species include toyon, hollyleaf cherry, coffeeberry, and other species. Snags and some large woody debris should be left in the planted sites to provide wildlife habitat.

Timing. This treatment is intended to be implemented on an opportunity basis; as trees die and other events appear to warrant some management response, action will be taken to enhance forest diversity and wildlife habitat.

Emphasis Area 8: Hazards and Landscaping

Location. These trees are located in high-use areas near buildings, within parks and developed recreation areas, and along roads and parking areas. Approximately 7,000 of these trees, including the 600 priority trees, have been precisely located and tagged. Most of them are in the northeast and southeast portion of the Presidio.

Management Situation. Landscaping trees are those not occurring in forest stands but standing alone or in small groups near buildings, within parks and recreation areas, and along roads and parking areas. Accordingly, these trees have relatively high aesthetic value. These trees also present the greatest threat of injury to individuals or damage to property because they are in high use areas. Most of these trees are in a late maturity stage and are increasingly subject to failure.

Emphasis Area Purpose. Within these areas, emphasis should be given to eliminating safety hazards and to maintaining or enhancing landscaping.

Emphasis Area Policies. The following policies should guide all treatment actions:

- o Treat decadent trees threatening life or property in priority based on probability and consequences of failure, using specific hazard reduction objectives and scheduled inventory updates.

Emphasis Area Treatments. The above policies should be implemented through the treatments below.

Hazard Tree Assessment. The 1989 Hazardous Tree Inventory, as continually updated, should be the mechanism to assess tree hazards and arrange treatment priorities. This system, described under "Present Forest Condition and Hazard" in Chapter 3 and in Appendix B, assigns a hazard rating based on both tree condition and potential "target." Trees assigned numerical ratings (unweighted) that exceed the priority threshold adopted by the City and County of San Francisco should be scheduled for treatment in the 5-year rating period. Approximately 20 percent of these trees should be treated each year.

Cutting Methods. Identified hazardous trees should be individually treated, either by removal or pruning. See "Hazard Tree Removal" in Chapter 6.

Revegetation. In general, each individual hazard tree removed should be replaced by another tree in the same location. In selecting replacements, consideration should be given to ultimate tree height and canopy spread in relation to buildings and other structures. Root morphology in relation to available rooting space, resistance of buried and nearby surface improvements, and soil strength should also be considered. Shallow-rooted species such as Douglas-fir and Monterey cypress should not be planted in cohesionless sandy soils that will have abundant moisture. Species likely to disrupt surface or subsurface infrastructure, including acacia, Monterey pine, and eucalyptus, should generally not be used. Preferable landscaping species are listed in Tables 5-4 and 5-6.

Site Protection and Seedling Maintenance. Plantings need to be protected from people and grounds maintenance equipment. Without protective measures, vandalism, inadvertent trampling, and mower damage may be so injurious as to cause two thirds of the landscape plantings to survive less than 10 years. Refer to "Seedling Establishment and Maintenance" in Chapter 6.

Timing. Hazardous trees should be treated before the onset of their estimated period of failure. Those trees that are expected to fail within 5 years and become a potential threat to life or property have been inventoried (Hermann Zillgens 1988). These 600 trees should be removed or otherwise adequately treated within the first 5-year period

Table 5-6. Medium and Large Trees for Landscaping at the Presidio

Common Name	Scientific Name	Comments*
Species Native to the Coastal Bay Area		
Madrone	<i>Arbutus menziesii</i>	ev, flrs
Tanoak	<i>Lithocarpus densiflorus</i>	ev
Knobcone pine	<i>Pinus attenuata</i>	ev
Bishop pine	<i>Pinus muricata</i>	ev
Coast live oak	<i>Quercus agrifolia</i>	ev
Willow	<i>Salix</i> spp.	dec, fall
Coast redwood	<i>Sequoia sempervirens</i>	ev
Species Native to Other California Regions		
Monterey cypress	<i>Cupressus macrocarpa</i>	ev
Catalina ironwood	<i>Lyonothamnus</i> spp.	ev, drt
Monterey pine	<i>Pinus radiata</i>	ev
Western sycamore	<i>Platanus racemosa</i>	dec, frt, fall
Canyon live oak	<i>Quercus chrysolepis</i>	ev
Valley willow	<i>Salix gooddingii</i>	dec, fall
Species Not Native to California		
Italian alder	<i>Alnus cordata</i>	dec, frt
Deodar cedar	<i>Cedrus deodora</i>	ev
Carob tree	<i>Ceratonia siliqua</i>	ev, drt
Eastern redbud	<i>Cercis canadensis</i>	dec, flrs, frt, fall
Washington hawthorn	<i>Crataegus phaenopyrum</i>	ev, flrs, frt, fall
Bronze loquat	<i>Eriobotrya deflexa</i>	ev, frt, drt
Red flowering gum	<i>Eucalyptus ficifolia</i>	ev, flrs
Cider gum	<i>Eucalyptus gunnii</i>	ev, flrs, drt
White ironbark	<i>Eucalyptus leucoxylon</i>	ev, flrs, drt
Silver dollar gum	<i>Eucalyptus polyanthemos</i>	ev, drt
Indian laural fig	<i>Ficus microcarpa</i>	ev
Moraine ash	<i>Fraxinus holotricha</i> 'Moraine'	dec, fall
Raywood ash	<i>Fraxinus oxycarpa</i> 'Raywood'	dec, fall
Australian willow	<i>Geijera parviflora</i>	ev, drt
Maidenhair tree	<i>Ginkgo biloba</i>	dec, fall
Chinese flame tree	<i>Koelreuteria bipinnata</i>	ev, dec, flrs, frt, fall
Tulip tree	<i>Liriodendron tulipifera</i>	dec, flrs, fall
Sweet bay	<i>Laurus nobilis</i>	ev
Tree mallow	<i>Lavatera assurgentiflora</i>	ev, flrs

Table 5-6. Continued

Common Name	Scientific Name	Comments*
American sweetgum	<i>Liquidambar styraciflua</i>	dec, fall
Southern magnolia	<i>Magnolia grandiflora</i>	ev, flrs
Chile mayten	<i>Maytenus boaria</i>	ev, drt
Flaxleaf paperbark	<i>Melaleuca linariifolia</i>	ev, drt
Italian stone pine	<i>Pinus pinea</i>	ev
London plane tree	<i>Platanus acerifolia</i>	dec, fall
Flowering pear	<i>Pyrus calleryana</i> 'Bradford'	dec, flrs, fall
African sumac	<i>Rhus lancea</i>	ev
Twisted hankow willow	<i>Salix matsudana</i> 'Tortuosa'	dec, fall
California pepper tree	<i>Schinus molle</i>	ev, frt, drt
Cork oak	<i>Quercus suber</i>	ev, drt

*Definitions of comment abbreviations:

- ev = evergreen.
- dec = deciduous.
- flrs = showy flowers.
- frt = showy fruit.
- fall = fall color.
- drt = drought tolerant.

of this plan. It is expected that a similar number of trees will have to be treated in each ensuing 5-year period.

Emphasis Area Objectives

Introduction

Objectives are quantified, time-dependent activity levels for implementation of policies to achieve stated goals.

The forest management policy articulated in the preceding portions of this chapter may be wholly or partially implemented within the 20-year planning period (1990-2010), depending on availability of funding. Funding sources and management activities possible at reduced funding levels are described in Chapter 8. In this section, the objectives for full implementation of the forest plan are considered.

Full implementation of the forest plan consists of a comprehensive program to implement each of the forest management goals and guiding policies within the 20-year planning period. Besides a sustained landscape-tree hazard reduction element, the program entails preservation of the remaining, original windbreak system by regeneration within 20 years of all of the windbreak stands currently exhibiting low vigor. Accordingly, approximately 50 percent of these and certain other forest stands would be regenerated within the 20-year planning period. However, the program defers regeneration of designated historical stands. The program includes historical stand treatments, native vegetation restoration and maintenance, visual screen development and maintenance, vista point view enhancement, control of tree topping, wildlife habitat and diversity enhancement, and control of damaging erosion within the planning period.

The hazard tree treatment element should be funded at a level sufficient to prevent or significantly reduce the threat to life or property, thereby resulting in an acceptable risk of liability for the U. S. Army in the event of tree failure. Thus, the program includes an aggressive hazard reduction element for landscape trees that calls for treating all of them prior to their estimated failure period.

Plan Objectives

Objectives for activities in each management emphasis area during the 20-year planning period are:

Windbreaks. On a scheduled basis, regenerate within 20 years all stands currently having low vigor (Appendix D). This entails 50 percent of the existing stand acreage, or an average of 3.1 acres per year. If major losses occur from an outbreak of disease, insect attack, or other environmental change, increase the rate of regeneration in proportion to the tree mortality rate.

Historical Plantings. Maintain stands as long as possible through sanitation cuts, weeding, and soil treatment. When necessary, regenerate as windbreaks. The estimated regeneration rate is 40 percent of the total acreage within 20 years.

Native Vegetation. Treat invasive plants in all established native vegetation areas every 5 years, and complete all restoration work in 20 years. Areas restored to native vegetation pursuant to this plan should be weeded annually or semiannually until the native plants are well established.

Visual Screens. Create all new golf course screens within 20 years and all other screens within 10 years. Maintain existing screens through sanitation cuts of dead and dying trees and plantings as needed. On a scheduled basis, regenerate low-vigor screens through small opening cuttings. Regenerate about 25 percent of the golf course screens and 40 percent of all other screens within 20 years.

View Enhancement. Initiate enhancement of the Inspiration Point and Rob Hill vista points within 5 years, and complete enhancement in three phases within 20 years.

Control Tree Topping. Convert to lower-stature stands in five strip cuts and replantings over 20 years.

Diversity and Habitat. In currently forested areas, regenerate or convert to diverse vegetation structure on a nonscheduled basis; treat an estimated 30 percent of the area within 20 years. Afforest some open areas (about 20 percent within 20 years) if available acreages are sufficient.

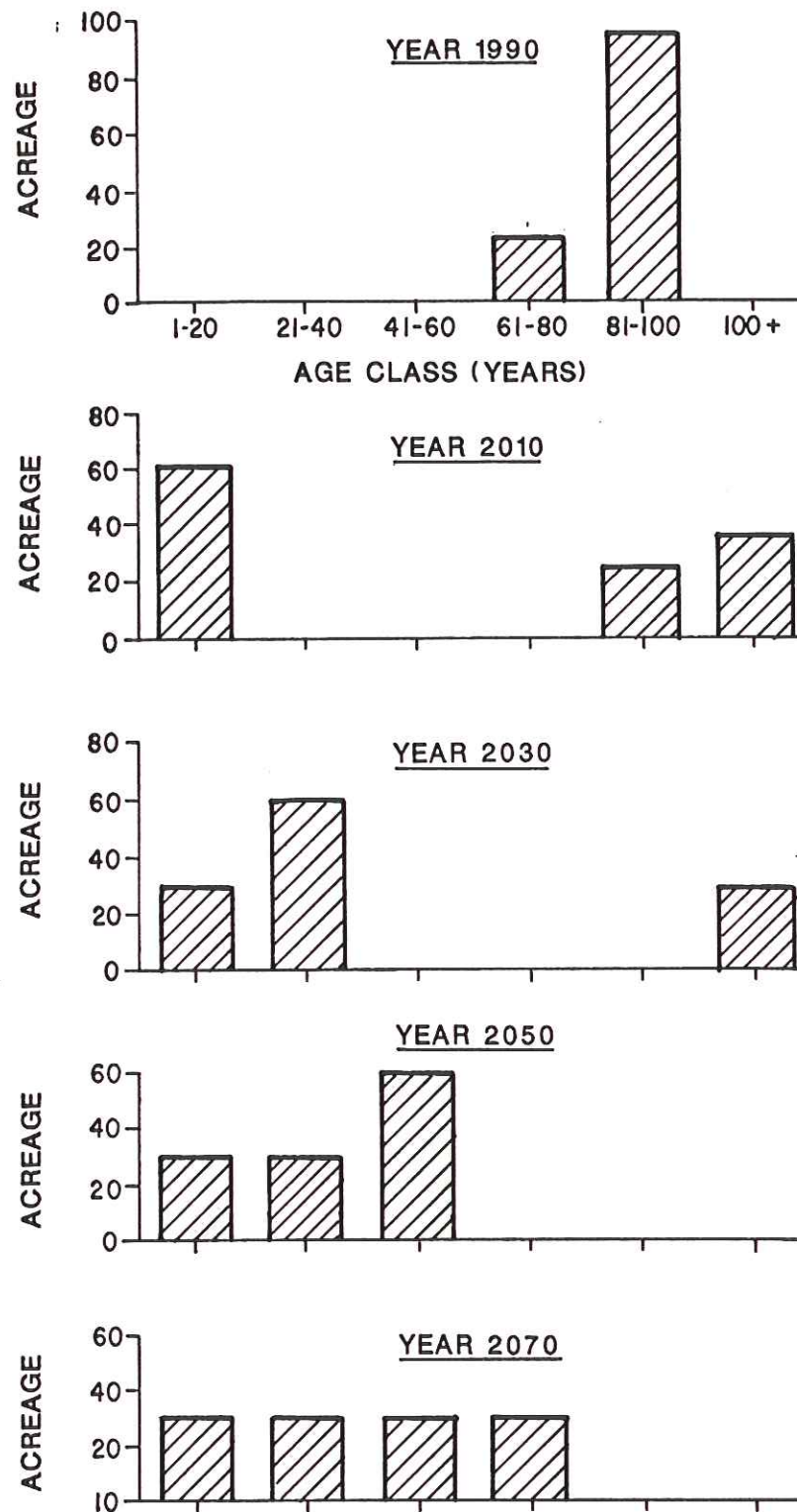
Hazards and Landscaping. Prune or replace all priority hazard trees before the estimated failure period, or 600 trees in each 5-year period (120 trees per year).

Erosion Control. As a part of, or in addition to, the emphasis area activities above, treat all identified significant erosion sites (Figures 3-1 or 5-1) within 5 years. Regenerate all low-vigor, dune-stabilization windbreaks within 10 years.

Achieving Forest Regulation

Because forest regeneration has been deferred during recent decades, the objectives for the planning period are relatively high. If this plan is fully implemented for 20 years and major outbreaks of forest pests do not occur, required activity levels during the ensuing decades should diminish. Those future objectives should eventually embody sustained forest regeneration and evolve the Presidio forest into a regulated forest. A "regulated forest" at the Presidio would involve similar continuous stand regeneration and hazard tree treatment levels in each decade. A regulated approach to Presidio forest management would avoid cycles characterized by little activity for several decades followed by periods of substantial effort to renew the forest simultaneously throughout the Presidio.

As shown in Figure 5-4, the planned average regeneration rate for windbreaks would drop from 3 acres per year to 1.5 acres per year after the planning period. Eventually, in about 80 years, forest regulation would be achieved. The long-term regeneration rate



NOTE: APPLIES TO 120 ACRES OF WINDBREAKS. ASSUMES 3 ACRES PER YEAR ARE REGENERATED UNTIL 2010 AND 1.5 ACRES PER YEAR THEREAFTER. EQUAL ACREAGES OF AGE CLASSES IN 2070 REPRESENTS ACHIEVEMENT OF FORESTED REGULATION.

FIGURE 5-4. WINDBREAK AGE CLASS DISTRIBUTIONS TO THE PLANNING HORIZON

would remain 1.5 acres per year. Similar reductions in treatment rates for the other emphasis areas would also be expected over the long term.

Treatment Scheduling

The scheduling of stand treatments and other activities to implement the plan should be carried out by the implementing forester (Chapter 8).

The priority of hazard tree cutting should be as determined from the hazardous tree inventory, based on its unweighted hazard rating system. This inventory should be updated by the forester as soon as possible (Appendix B).

The priority of stand cutting should be based on the best forest management practices ("Stand Cutting," Chapter 6) using Appendix D and Appendix I as a guide. Treatments throughout the various emphasis areas should be as needed to meet the objectives established above.

Chapter 6. Best Forest Management Practices

Introduction

Best forest management practices are the methods and procedures by which management intentions are implemented. The guiding policies of Chapter 4 and the emphasis area policies of Chapter 5 are operationalized through these best forest management practices. These practices apply to stand cutting, hazard tree removal, revegetation maintenance, tree pruning, woody debris disposal, fire protection, erosion control, and cultural resource protection. In this chapter, these practices are described in detail.

Stand Cutting

Stand cutting includes the practices necessary to identify potential reforestation areas, thoroughly analyze and plan cutting patterns, and safely implement tree-felling activities.

Planning

Each reforestation location should be selected carefully. The size of opening should be compatible with silvicultural requirements and management policy, and revegetation species should be adapted to environmental conditions.

Locating Stand Cutting. Determining the best locations of reforestation sites throughout the Presidio forest depends on many factors, some of which may vary over time. These include vigor of stands, funding levels, management emphases, previous cutting pattern, visibility, unexpected events, accessibility, proximate land use, and local environmental conditions.

Tree Vigor. Stands with low vigor, as identified in Appendix I and through field observations, should be the focus of stand cutting throughout the planning period.

Funding Considerations. If funding is available for only partial implementation of the forest plan, reforestation should take place in areas where serious forest decline is occurring and is hazardous to people, property, or the adjoining forest.

Management Emphasis. The number of reforestation sites to treat in each emphasis area each year depends on the forest management objectives stated in Chapter 5.

Previous Cutting. Within an emphasis of a group of stands, the location of reforestation areas should be separated from one another wherever possible. Stands comprising practical future cutting units should be maintained between the recent cutting areas. If reforestation areas are situated too close to each other, wind may destroy the intervening stand.

Visibility. The public tends to view live tree cutting negatively. Accordingly, an effort should be made to mix highly visible openings with more obscure openings during each cutting year.

Opportunity. Destructive natural events occur frequently in the Presidio forest. Wind storms, fires, and other land clearings provide reforestation locations of "opportunity." These opportunities should not be ignored when they arise. The first experiments with reforestation were in areas cleared because of the winter storms of 1982 and 1983. Currently, many openings throughout the Presidio forest need to be revegetated because of tree mortality and removal.

Access. Reforestation plots must be accessible to vehicles. Access routes should be identified and fully utilized before the tree removal occurs.

Environmental Constraints. Wind, sunlight, moisture availability, and soil are the chief factors affecting locations and boundaries of reforestation areas and species choice.

Wind can damage exposed mature trees left at the edges of openings where an open corridor, such as a road, allows funneling of wind through the site. Wind can also affect the survival of young trees in areas where an opening is large enough to allow airflow to drop to ground level.

Sunlight is controlled largely by aspect and opening size. Northern aspects require larger openings for sufficient sunlight in relation to southern exposures. Size determination is discussed below.

Serpentine soils support only eucalyptus and a few native tree species. The dune sands do not support tree species that require moisture during summer. Openings in these areas (Figure 3-1) should be created with reasonable expectations for the nature and extent of regenerated vegetation.

Selecting Silvicultural Methods. Silviculture is the science of growing and tending forest trees. At the Presidio, it is the process of controlling the establishment, composition, and growth of the introduced forest. Four distinct silvicultural cutting practices should be used on the Presidio to meet silvicultural needs and emphasis area requirements. These four methods are: 1) single-tree selection, 2) group selection, 3) thinning, and 4) sanitation. Clearcutting, a fifth method, should only be used on the Presidio in response to widespread simultaneous tree mortality from catastrophic events.

Single-Tree Selection. This method should be applied in Emphasis Areas 4, "Screens," and 9, "Hazards and Landscaping." Trees selected for cutting should be

overmature, suppressed, or defective. Other reasons to use this cutting method are to eliminate unwanted species and to obtain better spacing.

Group Selection. This should be the most prevalent method of cutting in the Presidio forest, and it is used in Emphasis Areas 1, "Windbreaks"; 6, "Control Tree Topping"; and 7, "Diversity and Habitat". This cutting method involves clearing small areas of trees in a systematic pattern over a specified time. Clearings should be at least large enough to allow adequate light to reach the ground for seedling survival and growth.

Group Selection - Fallen Tree Variation. Another method of selecting areas to be cut uses the point at which a tree falls naturally as the center of the group selection. The size of the cut area would be the same as for regular systematic group selection cutting, but areas cut would be randomly located, based on tree failures. If a fallen tree is to be removed and equipment will be present in the stand, concurrent removal of an adjacent group of low-vigor trees may eliminate the need for future site disturbance in that area. This variation of group selection should be used in Emphasis Area 7, "Diversity and Habitat."

Sanitation. Key historical stands are to be maintained as long as practicable. This cautionary step requires frequent reentry into these stands to remove the dead, damaged, diseased, or infested trees or portions of trees to prevent the spread of pests or pathogens and to promote forest vigor. Once the density of trees in a stand is below an average basal area of 100 square feet per acre, the stand should be regenerated using the group selection process. (Basal area is the aggregate cross-sectional surface area of a stand of trees measured 4.5 feet above the ground.)

Thinning. This cutting procedure should be used on all new stands and in some current stands of Emphasis Area 4, "Screens." Trees in crowded stands tend to grow slowly. Indicators of the need to thin are closeness of trunks, crowding or overlapping of tree crowns, and thin stems. Thinning releases the trees from excessive competition and stimulates greater growth, as well as removes those defective or malformed trees that will become a hazard in the future. Young tree stands should be thinned every 5-10 years until the stands reach peak condition.

Determining Size of Openings. The size of a revegetation area depends on biological requirements, wind conditions, and potential visual impacts.

Biological Requirements. The minimum area size to be cleared on the Presidio under the group selection method is twice the height of the trees being removed, or an average of about 0.5 acre at the Presidio. If sunlight is already available, such as that around areas adjacent to roads, a smaller size cut can be made. In the fallen tree variation of the group selection, opportunity plantings can be made adjacent to other planted sites. If many trees naturally fail, an opening larger than the minimum can be used. In areas being initially managed under the sanitation cutting method (e.g., historical stands), eventual reforestation may encompass significantly larger openings.

Visual Impacts and Wind Exposure. The smaller the clearings for reforestation purposes in visible locations, the fewer the concerns of the public will be toward tree cutting. As noted earlier, adverse impacts of wind in large reforestation

clearings can be substantial. Thus, the standard practice should be to restrict clearings to the smallest opening that will allow sufficient light to the ground to grow new trees, as defined above.

Preparing Cutting and Revegetation Plans. Before any cutting occurs, a written site-specific cutting and revegetation plan should be developed. It should address the following:

Assurance of Revegetation. Every cutting unit should be successfully replanted in conformance with this management plan and with site-specific revegetation plans.

Compatibility with Landscape Design. The Presidio forest landscape, as designed by Major Jones, requires that the forest look continuous and natural. Planting plans should specify the intended purposed of specific areas, such as a ridgetop windbreak, forested open space, boundary screening, or gateway planting.

Location. Also, as noted earlier, the reforestation sites should be dispersed enough so that they seem to evolve as part of the landscape.

Species Selection. To avoid a planting failure because of an outbreak of a possible uncontrollable disease or insect infestation in the next 80 years, several species of trees should be planted at each site. Every tree species has its own tolerance to sun, wind, and drought, which should be reflected in the reforestation plan.

Maintenance Needs. Replanting in this harsh environment requires a significant commitment to seedling maintenance, such as eliminating competitive weeds and providing water during the dry summer months. Needs will vary at each site, so each site requires a unique maintenance plan. The following "Revegetation Maintenance" section describes the range of maintenance practices.

Site Preparation. Plans should take into account how maintenance crews will access each cutting unit for the next decade. Temporary roads may have to be installed, and soil disturbance mitigation may be required. Unwanted trees, which may compete with planted trees such as naturalized eucalyptus, may have to be removed and stumps treated with herbicide. Existing water lines and other utilities must be avoided. Surfaced roads not designed for heavy equipment must be tested.

Planting and Maintenance Schedule. All reforestation work is seasonal. New trees are planted in winter and early spring, older trees are pruned and thinned in late fall and winter, and site preparation is done throughout summer. By performing work during the proper season, tree establishment success increases, pest problems diminish, maintenance requirements decrease, and soil resources are better protected. (See Chapter 6, "Seedling Establishment," for a seasonal calendar of reforestation activities.)

Cutting and Preparing for Revegetation

This phase should be coordinated with the maintenance staff at the Presidio. Management effort must be committed to developing coordinated plans and time tables for action on the ground.

Preparation. In the urban environment, many obstacles may hinder the movement and removal of large trees. Improvements and other vegetation should be protected from damage during removal operations. Locations of structures (fences, buildings, parking lots), overhead or underground utilities, usable access routes, erodible soils, and hazardous trees on the site must be determined. Depending on the problem, appropriate personnel (e.g. plumbers, iron workers, masons) should be contacted to perform required site preparation work. Specialized laborers, such as heavy equipment operators, truck drivers, and skilled arboricultural or silvicultural crews, will need to be contacted and specific equipment assembled.

Tree cutting is dangerous, and every site presents unique hazards. All employees should be made aware of the site-specific hazards. Plans for the safety of passersby should be developed and implemented.

Individuals can disrupt a project if they are not given adequate, reliable, and prompt information about the work. On highly visible projects, or where a potential exists for public opposition, the work crews and the base public relations officer should be informed about the specific reforestation plan. Neighborhood associations should be notified before tree cutting operations are conducted adjacent to homes or roadways.

Cutting. Because every site is unique, cutting procedures must be developed on a case-by-case basis. In general, access must be developed, underbrush cleared, trees removed, woody debris treated, and the area cleaned up and prepared for winter planting.

Stump Treatments. Stumps should normally be cut within a foot of the ground. A grid of saw cuts should be made into the stump surface, and soil should be shoveled into the surface to accelerate stump rotting. In addition, eucalyptus stumps may need to be treated with herbicide. In visually sensitive areas, stump grinding should be considered.

Disposing of Debris. Treating the woody debris is the most expensive and time-consuming operation in preparing a site. Small limbs and branches should be chipped onsite and broadcast as mulch. The large stems should usually be moved offsite; see the "Woody Debris Disposal" section in this chapter and Chapter 7, "Recovery and Utilization of Wood Resources."

Providing Interim Management. The revegetation site should not be planted until the winter season. This requires that the site be protected in the interim from unauthorized uses, such as auxiliary parking, picnicking, and off-road driving because these uses may continue after the site is planted. If water is available, a planting of lupine or other temporary ground cover may be used to discourage unauthorized use of these areas.

Equipment

The following equipment is appropriate to use for stand-cutting activities.

Pickup Trucks. The pickup truck is the primary personnel transporter, equipment mover, and general work tool for reforestation crews. The heaviest duty pickup truck that a crew member can drive should be used, or one with a load capacity of three-quarter or

1 ton. Because most work will be done off road, four-wheel drive is necessary. Towing packages consisting of large engines, low-ratio rear ends, and transmission coolers are useful in extending the vehicle life. Other useful options are dump beds (pickup bed lift), utility boxes, winches, and crew cabs.

Tractors. Two types of tractors should be considered for stand cutting and reforestation: a heavy-duty skidder and a small farm tractor.

An average mature tree weighs about 15 tons. The most desirable tractor to move fallen trees of this size or larger is a skidder equipped with a winch. It can also be used for felling hazardous or difficult trees in sensitive areas. A specially trained operator is required to operate this tractor.

The second kind of tractor is a small, four-wheel-drive farm tractor. These tractors do not have the pulling power of a heavy-duty skidder but, with additional labor, they can move trees in smaller pieces. The farm tractor with a three-point hitch can also serve as a weed tiller for revegetation maintenance, a stump grinder, a spary rig for watering and weed management, a ditch digger for temporary irrigation lines, an auger for tree planting at difficult sites, and a bucket to load and spread chips and move small pieces of wood into pickups. Although an experienced crew member can use this size tractor, a specialized operator would ensure greater safety.

Front-end loaders and other tracked equipment presently used for these purposes have caused damage to the soil and adjacent trees.

Chippers. Two kinds of chippers are available, the flail and disk type. The flail type is currently used by the Presidio staff, but it is highly unreliable. This type of chipper needs constant attention, and its use for substantial chipping operations is infeasible. The disk type is a slower but safer chipper that can handle much larger diameter branches and tree stems. Although the disk type breaks down far less often, all chippers require frequent maintenance. Equipment quality, preventive maintenance, operator care, parts availability, and the presence of a back-up chipper are the keys to a successful chipping operation.

Winch/Dump Truck. A specialized truck is needed to handle large tree trunks and roots. The winch can perform many of the operations of the large tractor noted above. This equipment can also tow tractors, chippers, and slip-on watering tanks.

Trailer. Moving tractors, stump grinders, ditch diggers, chips, and soil to and from work sites will require a trailer. This trailer should have the capability to be lowered mechanically or hydraulically so that equipment can be driven onto it.

Stump Grinder. A stump grinder must be of high quality and have regular maintenance. The ideal stump grinder is a four-wheel-drive vehicle that can move on slopes.

Chainsaws. Equipment quality and uniformity are important. All saws used by the Presidio staff should be the same. Such product uniformity is important for maintenance, employee safety, and training.

Climbing Gear. New equipment is being put on the market regularly. The advantages of some of the new gear are better support for climber back-related stresses and improved safety features.

Cables and Ropes. Over the years, the strength and handling characteristics of ropes and cables have been greatly improved. Nonetheless, all ropes and cables need to be periodically replaced.

Winches and Blocks. Modern equipment should be acquired for ease of handling and safety. Using winches, cables, and blocks for tree removal is a cost-effective but dangerous procedure, and proper equipment is essential.

Radios. Most of the reforestation work is in off-road areas where heavy equipment is in constant use. Mobile radios are necessary for employee safety and for coordinating equipment use.

Safety Gear. Tree cutting is one of the most dangerous occupations. The California Occupational Safety and Health Administration and the California Department of Agriculture require specific equipment. Because their requirements change every year, these agencies should be contacted regularly.

Hazard Tree Removal

All tree removal operations are hazardous, but removal of defective and senescent trees at the Presidio is needed to provide safe conditions for users of the base.

Assessing Removal Need

Because of limited funds and the large number of hazardous trees, a hazard-tree ranking system has been established at the Presidio to guarantee that the most hazardous trees are treated first. The 1988 Hazardous Tree Inventory identified high-risk areas within the forest, inventoried the trees in those areas, and set up a system to rate potentially hazardous trees. Although the inventory requires further work, it can begin to be implemented immediately. Additional funding is needed, however, for further identification of hazardous trees.

In the inventory system, trees are evaluated and assigned hazard control numbers (HCN). This assignment is based on a mathematical formula that incorporates the probability that a tree will fail within 5 years, the probability that the tree will strike a target (person or property), and the potential damage that could result.

Once trees have been rated, those with a HCN above a selected threshold are scheduled for treatment. A reasonable HCN goal for the Presidio would be to treat all trees with a HCN over 200 within the next 5 years. The HCN threshold can be lowered in the future if a significant level of tree failure persists and funding is available.

Trees should continue to be assessed and records kept. Trees to be removed should be identified and removal scheduled as needed to comply with the hazard tree removal objectives of this plan (Chapter 5).

Repairing Trees

Hazardous trees considered valuable because of their appearance or their historical value should be considered. Thinning the crown, redistributing tree weight, removing a limb, or cabling or bracing certain parts can extend a life of a tree and substantially reduce its potential hazard.

Pruning and Tipping. The crown of a tree that may be subject to windthrow can be pruned by removing every third limb or so. This will allow the wind to pass through the tree without dislodging it. Oversized branches may also be tipped.

Weight Redistribution. Many trees adjacent to clearings will naturally grow toward these spaces, developing lopsided crowns. By carefully tipping or pruning the heavier side, a tree's weight can be redistributed to temporarily lessen the potential hazard.

Limb Removal. Some hazardous trees need to have only a few large limbs removed to diminish their potential hazard. Appropriate pruning methods can eliminate this hazard without excessive visual degradation. If this approach would cause an unacceptable visual consequence, cabling or bracing should be considered.

Cabling or Bracing. Cables and braces are expensive but appropriate tools to use for high-value trees that have the potential to fail. These supportive aids can extend the life and preserve the form of specimen trees for several years, if the structures are maintained.

Removing Targets

Another method of retaining a potentially hazardous tree is to remove the target that could be damaged by the failed tree. Paths, picnic tables, bus stops, and benches can be relocated inexpensively so that the chance of someone being under the potential hazard is diminished. Public use could be restricted in forested areas with a large number of hazardous trees, at least during severe weather when tree failures generally occur. Temporary buildings, utilities, and parking locations could also be moved if an adjacent specimen tree appears capable of causing damage.

Removing Trees

Notices. Trees rated as potentially hazardous are generally located in high-use areas. Depending on the trees' location, a notice of removal should be issued either to the Presidio management staff or by placing notices on the trees.

Removal Operation. When a tree should be removed because of its potential hazard and alternative hazard reduction methods are too costly or are infeasible, the correct removal technique should be chosen to fit the circumstance. Removing large trees from limited areas requires specialized labor, as noted in the previous "Stand Cutting" section. This work is dangerous and slow. Two climbers should be present at all times. Usually only one person can be in a tree at a time, cutting it down piece by piece. The second climber can function as the ground person but be available to rescue the first climber in case of emergency. Other needed personnel may include a specialized faller, a rigger, heavy equipment operators, and laborers to chip and/or haul away the debris. Boom trucks are being used to perform most pruning and tree removal work, but the tops of eucalyptus trees often exceed the reach of the highest boom truck. Thus, climbers must be used.

Ensuring Safety

Any work in or around a tree can be dangerous to both employees and the public. Safety precautions often take up to 30 percent of the time needed to remove trees. However, negligence can be even more expensive.

Personnel. The California Occupational Health and Safety Administration has issued regulations establishing proper safety practices for tree workers. The American National Standards manual *Tree Pruning, Trimming, Repairing or Removal* (ANSI Z133.1), covers safe work practices in the tree by the employee. The International Society of Arboriculture has also issued safety guidelines for the tree worker and administers a program to certify tree workers in safe climbing practices. All these standards should be observed.

Public. The public should be kept away from potential hazards during tree removal operations. When a standing tree is identified as an immediate safety hazard, barriers should be placed in the hazard area until the threat is eliminated. While operations are in progress, identifiable barriers and signing need to be in place to divert and redirect pedestrians and vehicle traffic.

Required Equipment

Aerial lifts, pickup trucks, winches, chainsaws, climbing gear, ropes, cables, and safety equipment are needed and are discussed in detail in the previous "Stand Cutting" section.

Revegetation Requirements

Revegetation practices described herein are manual tree planting methods intended to be used to restock trees in the existing forest stands. Revegetation maintenance is described in the following "Revegetation Maintenance" section.

The planning process for revegetation begins with a review of the objectives of the forest management plan and budget planning. Before planting can occur, stand cutting must be complete.

As noted in the "Stand Cutting" section, each cutting and revegetation operation should be preceded by preparation of a written plan. This should take place before trees are cut or the ground is disturbed for revegetation purposes. The following aspects of revegetation should be addressed in these plans.

Determining Soil Management Needs

Most of the Presidio soils do not have sufficient nutrients or water-holding capacity for ideal tree growth. Most of these soils are slightly loose or weakly connected sands originating from dunes or the weathering of sandstone, or are iron- and magnesium-rich soils derived from serpentine. Accumulated forest litter-fall has developed a thin topsoil layer under these trees (Amundson pers. comm.). The next generation of trees should grow slightly better than the original forest because of a small improvement in water-holding capacity and cation exchange.

Soil Amendment. Soil amendment is not required for planting bare root stock. For planting container stock, sandy soils should be amended with clayey soils not derived from serpentine to improve water-holding capacity and cation exchange. Slow-release fertilizer pellets (e.g., 6- to 9-month 14-14-14) should be placed near the bottom of the planting holes.

Where hand watering will be used, a soil berm should be constructed to form a watering basin. In the areas of cohesionless dune sands, the addition of some clay will be necessary to keep the berm from washing away.

Mulch. Mulch reduces weed competition with young trees and increases the moisture-holding capacity of the planting site. Three mulching materials are suitable for reforestation at the Presidio: wood chips, tilled ground cover, and textiles. Forest litter can sometimes be used for mulch, but only the eucalyptus trees at the Presidio have produced much litter, and eucalyptus litter acts as a growth suppressant, inhibiting seedling survival and growth.

Wood chips are the most desirable mulch to use for reforestation purposes at the Presidio and should be in ample supply. Before wood chips are applied, ground cover at the planting site should be spaded into the soil. As an alternative or a supplement to wood chips, permeable woven plastic sheets (3 feet by 3 feet) can be used at each planting site. If the sheets are visible, however, they may encourage vandalism and result in loss of the planting stock.

Erosion Control. Erosion control is described in the "Erosion Control" section.

Selecting Planting Materials

Types of Planting Stock. The best seedling is the smallest and youngest nursery-grown tree that is practical to plant in an urban area. A larger seedling size may be necessary in highly visible areas. Nursery stock comes in many forms: bare root stock, liner stock, and container stock.

Bare Root Stock. One-year-old bare root seedlings should be the basic stock used in replanting the Presidio forest. This seedling stock is the same type used in the initial planting of the Presidio forest. Bare root stock seedlings generally perform better than all other stock because root growth has not been inhibited in the nursery.

Liner Stock. Liners are plastic sleeves that allow uninhibited downward growth of the seedling's tap root. They are used to root seeds, and are ready for planting when the seedling is only a few weeks old. Liner stock performs as well as bare root stock, but usually costs more. Liner stock should also be considered for widespread use at the Presidio.

Container Stock. Container stock is generally inferior to bare root and liner stock because root growth has been deflected from the vertical. Although the planted stock is larger, performance will be markedly less in comparison to the bare root and liner stock. As noted, container stock should be used only where immediate, high visibility of the planted stock is needed.

The most common container stock is the 1-gallon-container tree. By the time a tree has reached this container size, it has usually been transplanted three times. In contrast, a 15-gallon-container tree has a poor chance for growing into a strong, healthy tree. One of the biggest problems with larger container stock (i.e., 15 gallons or larger) is that the roots tend to encircle the root ball and girdle the tree later in life.

Condition of Planting Stock. Seedlings should be young, healthy, and vigorous. The initial cost of a seedling is minor compared to the cost of planting and maintenance. A seedling in poor condition will not become a strong, healthy tree and should be discarded.

Inspection. Trees purchased from a nursery or grown in-house should be personally selected by the implementing forester. Representative trees of the potential planting stock should be inspected to determine the extent of their roots, their root-to-shoot ratio, and their overall development. Stem and foliage diseases and related problems should also be noted.

Genetic Considerations. Seedlings should be of local origin wherever possible. Trees grown locally have adapted to the local climate and other environmental conditions. If the selected seedlings are not suited to the local climate, entire planting areas can be lost, perhaps well after their initial establishment. Such an event would be a substantial financial and aesthetic loss.

Propagation of seedlings from seeds produced at the Presidio may hold the most promise of success in this regard. Trees with good genetic characteristics, such as superior aesthetic form, excellent branching habit, or longevity, should be selected as sources of seed. For species that are not now present, seed should be selected from sources in nearby areas with a similar climate. Sources could be on islands in the San Francisco Bay or southward along the coast, where the precipitation is similar. The north coast tends to be colder and wetter and, except for southern Marin County, would be less apt to produce seed adapted to the site.

Coppicing. Sprout management, called coppicing, can be used for forest regeneration. A major benefit of this technique is that genetically adapted trees are always produced.

Planting

Planting should be generally done in December, January, and February. A yearly calendar describing seasonal activities, including planting, is described in the "Revegetation Maintenance" section. Planting should be done by experienced planters or by workers who have received training from, and are under the supervision of, experienced workers.

The actual planting process can be split into five steps: 1) caring for the seedlings from the nursery to the planting site, 2) installing the planting hold, 3) inspecting the root system, 4) planting the tree, and 5) providing immediate care.

Preplanting Care. Trees should be brought to the planting site with great care and minimum stress. They should not be exposed to severe wind or excessive heat in an open vehicle.

When bare root seedlings are moved from the nursery, they should be planted as soon as possible, at least within 48 hours. Containerized seedlings allow much more flexibility in planting timing but present a greater transport problem (200 containerized trees versus 10,000 bare root trees per truck load). Containerized stock should be handled by the container, rather than by the stem because stem injury may be caused by the weight of its root ball.

Bare root trees should be planted immediately after they are removed from the nursery. If they cannot be planted immediately, interim steps should be taken, such as placing the seedlings' roots into a moist medium (heeling-in) or putting them in cold storage. During storage, the roots should be covered at all times, and growth should be prevented.

Containerized stock, on the other hand, should be acclimatized to the local weather prior to planting. This will harden them while they are secure in their containers. The plants and containers should be protected from desiccation and extreme heat.

Planting Hole. For container stock, the planting hole should be twice the width and one and one-half the depth of the seedling container. The sides of the hole should not be smooth or glazed (as is often caused by augers and wet conditions) because the seedling roots will not penetrate this surface and will spiral inside the hole. The soil removed should be the backfill and should be stockpiled onsite.

Bare root trees should be planted into a shovel slit rather than a hole, as described below.

Root Inspection. All seedling roots should be inspected, and the matted, dead, diseased, broken, twisted, and circling roots pruned. For most containerized nursery stock, a deep vertical cut should be made on opposite sides of the root ball to deter root girdling.

Inspecting and pruning the seedling roots should be done very quickly because every minute of root exposure to the air results in a significant loss of root hairs.

Seedling Planting. The primary rule of planting small trees is to make sure that all roots are not kinked upwards, or "J" rooted.

Containerized Trees. To plant containerized trees, the loose soil at the bottom of the hole should be formed into a slight mound in the center on which to set the root ball and spread out the bare roots. The root crown should be level with the natural terrain (in sandy conditions). The backfill soil should be worked around the roots so they are not compressed into a tight mass, but are spread out and are supported by soil beneath them. After each three or four inches of soil has been placed in the hole, the soil should be firmed around the roots with foot pressure, with care taken not to tear, bruise, or debark the roots. If the soil is dry, water should be applied before, during, and after the planting. Postplanting watering will eliminate possible air pockets and settle the root ball into its final position.

Bare Root Trees. Planting bare root trees requires a different technique. Planting bars, the mattock, the western planting tool, and the shovel are commonly used for bare root planting. The hole should be made about 10 inches deep with a nearly vertical wall on one side. A tree is taken out of the planting bag in which it is kept moist, checked for root defects, and set into the ground by suspending the tree against the vertical wall slightly lower than natural grade. The roots are spread out fanwise, and the hole is filled by holding the tree in one hand and packing the soil in with the other. The planting should be completed by firmly packing the soil with foot pressure.

Postplanting Care. Newly planted trees require watering and monitoring for several weeks to ensure successful establishment.

A newly planted tree will need several waterings during the planting day and shortly thereafter, depending on weather. A watering basin should be installed at the time of planting, as noted under "Determining Soil Preparation Needs" above.

Staking. Planted seedlings will not need staking except where stakes provide a deterrent to mower damage.

Pruning. If trees have a poor root-to-shoot ratio (i.e., the top of the tree is much greater than the bottom), corrective pruning should be done to decrease the foliage. About a quarter of the foliage can usually be removed without affecting tree health.

Quality Review. In the last few weeks of the planting season, a few planted seedlings on each site should be destructively sampled by the implementing forester to inspect for planting problems, site problems, and seedling progress.

Maintaining Revegetation Sites

After the planting phase is completed, the watering, weeding, pruning, thinning, and other maintenance programs should be implemented. These activities are described in the "Revegetation Maintenance" section.

Equipment

Equipment required for the tree planting phase is limited to vehicles, planting tools, watering tanks and hoses, augers, shovels, hoes, rakes, and other small equipment.

Revegetation Maintenance

This practice describes the procedures needed to ensure that planted trees and other vegetation will survive and grow to their full potential.

Calendar

Revegetation and maintenance should be properly timed. If necessary, trees can be planted at any time during the year but survival rates may be lower and maintenance costs higher. By following seasonal patterns of reproduction and growth, however, reforestation and maintenance work will be more successful and cost effective.

For this purpose, the following monthly calendar should be used as a guide for managing the Presidio forest. Only those activities that are seasonally dependent are included. Categories of work used in the calendar are:

- R - stand cutting and revegetation,
- M - revegetation maintenance, and
- A - administrative work.

January

R. This month is the peak of the planting season, which starts in December. Exceptionally poor weather can delay some tree planting, but the majority of the trees should be in the ground by the end of the month.

M. If necessary, minor pruning of seedlings and saplings should be done at this time, because both trees and insects are inactive. Emergency storm damage work will be necessary as older trees fail throughout the winter.

A. CPR, first aid, and other safety-related reviews should be performed.

February

R. All reforestation work to be undertaken by base personnel or under contract during the season should be completed. Trees should be planted where hazardous trees have been removed throughout the year or where landscaping trees failed during winter. Shrubs and wildflowers should be planted in the 5- to 7-year-old reforestation areas.

R. The slower growing tree species, grown for the next season by on-base or contract nurseries, should be germinated.

M. The remaining saplings not thinned in December because of soil or weather conditions should be removed and chipped.

March

R. Arbor Day tree plantings by volunteers occur.

R. Areas considered for cutting in summer should be assessed regarding desired tree species, planting stock availability, irrigation needs, visual impact, and accessibility.

M. Weather permitting, weed control should be the most important activity for the month. Trees damaged by winter storms should be reassessed, and those considered too hazardous to repair should be scheduled for removal.

April

M. Temporary irrigation lines and water tanks should be installed where needed.

M. Hazard tree removal, weeding, and watering schedules should be developed and implemented as weather permits.

M. Community volunteers participating in the Sixth Army's "Army Days" should be used to weed revegetation plots and remove invasive species for native plant communities.

May

R. Monterey pine and cypress should be germinated midmonth so that they will be the proper planting size by winter. All equipment and specialized personnel should be scheduled for the annual stand cutting program.

R. All revegetation plantings should be evaluated annually for vigor, pathogenic influences, and need for thinning, weeding, pruning, and replanting.

M. Weeding and water of revegetation plantings should be done; see "Water Maintenance" section in this chapter.

June, July, August, and September

R. These 4 months should be devoted to stand cutting.

R. Container stock awaiting use should be transplanted into larger containers so that root growth is not impeded. Specialized safety training for crews working on stand cutting should be provided.

M. Watering should be done as discussed under "Water Maintenance." Routine weeding should be done to extend the interval between watering; see "Weed Maintenance."

A. Prepare budget, personnel, and equipment requests for subsequent fiscal year.

October and November

M. All revegetation plantings less than 3 years old should be inspected for mortality and stress-related problems. Trees should be marked in plots that are to be thinned. Planting areas should be cleared of all competing vegetation and woody debris that will hinder winter planting because most areas will not be accessible to vehicles until spring.

M. Weeding and watering should be gradually diminished and terminated when fall rains begin.

A. The areas selected for planting should be mapped, and the number of trees and a planting sequence should be established. Trees that are not grown under contract, such as those from the California Department of Forestry and Fire Protection, should be ordered. Trees planned for winter thinning should be marked. San Francisco observes Arbor Day on November 1, and this day should be used to educate the public about the Presidio's revegetation program.

December

R. Tree planting should begin, weather permitting. Tree roots grow during the winter, so it is important to plant as soon following the onset of winter rains as possible. Special planting prescriptions requiring scattering pregerminated seeds, planting large stock, and planting in extremely sandy soils or windy locations should be accomplished first. Thinning of the older stands should begin as soon as winter temperatures have caused insect activity to cease.

M. Minor pruning of the smaller trees should be done. All woody debris should be taken offsite and chipped to prevent insect infestation later.

A. Additional patrolling of the forest should be scheduled up to Christmas to prevent tree theft in the reforestation areas. Equipment maintenance, ordering, and testing should be done. Nursery contracts establishing tree numbers and species for the

following year should be consummated. Yearly goals should be evaluated and next year's goals established.

Maintenance of Seedlings and Saplings

Revegetation maintenance involves eliminating competitive weeds, providing water during the dry summer months, and thinning plantings. Because watering will be dependent on local sources and site access, and because weeding intensity will depend on watering, each planting site will require a distinctive maintenance plan. As the seedlings become saplings, they will start to compete with each other, and a thinning process should be implemented.

Maintenance Periods. Four maintenance periods can be distinguished.

0-1 Year. The first year of a seedling's life will determine whether it will be a successful, dominant, trouble-free tree or a sickly, suppressed tree that will be a long-term maintenance problem. The most important maintenance steps during this period are to water, weed, and constantly monitor these trees for problems.

1-3 Years. The seedlings are constantly cared for through a rigorous watering and weeding program. Poorly established trees are eliminated, and, if necessary, planting sites are replanted. Obviously defective branch growth is pruned.

3-7 Years. The sapling stage requires careful thinning, monitoring, and preventive maintenance. The saplings are thinned and possibly pruned. Brush species are established to increase structural diversity.

7-11 Years. The trees are integrated into the surrounding forest by additional thinning and removal of potentially hazardous branch growth. Revegetation maintenance is discontinued as saplings become well established.

Watering Maintenance. Seedling watering, necessary to establish the original forest, requires considerable effort and expense. By carefully monitoring weather and soil conditions, confining watering to seedling root zones, and keeping aggressive weeds to a minimum, the effort and cost of watering can be greatly reduced. If irrigation is infeasible, planting should not be undertaken during dry years.

Watering Rates and Schedules. Newly planted trees may need several waterings during the planting day and the days immediately following, depending on temperatures, precipitation, and soil conditions. During wet periods, little initial watering may be required. Watering basins around each plant should have been installed at the time of planting. These initial actions are described in the "Revegetation" section above.

During the first growing season, an average of 2-3 gallons of water should be applied to each seedling three times per month during summer (June through September) if hand watering rather than drip irrigation is used. Watering in spring should also be done if spring rains are not substantial. One watering in March and two waterings per month in April, May, and October are normally required. Adherence to frequent watering, as

described, is more critical to seedling survival than is the amount applied. Watering should be initiated when the soil surface has dried below a depth of 4 inches.

During the second maintenance period (1-3 years), watering frequency can be diminished. Only one watering per month may suffice between May and September. Watering may not be needed during the third summer.

Watering schedules and application rates should be adjusted as reforestation proceeds and experience is gained. Moreover, monitoring soil moisture should result in more frequent watering during prolonged warm, fog-free periods.

These schedules are based on needs of drought-tolerant seedlings growing in sandy loam soils in a Mediterranean climate. Relative water demand at the Presidio may be diminished by frequent cloud cover and fog drip in summer, but a major reduction in watering needs should not be assumed.

Revegetation species described in Chapter 5 are all drought tolerant. If drought-intolerant species are used, however, the tentative average watering schedules should be increased substantially. Summer irrigation should be doubled during the first year (to six times per month) and tripled during the second year (to three times per month). Watering should occur once per month during the third summer for drought-intolerant species.

If drip irrigation is used instead of periodic hand watering, the total seasonal water application would diminish.

Water Sources. Several methods of delivering water to revegetation plantings should be considered on a site-specific basis, including:

- A. conveyance through buried hoses from the Presidio water system to the site, employing a drip irrigation system or manual application;
- B. delivery via tanker truck or tractor-drawn tank, employing manual application;
- C. delivery via tanker truck to onsite storage drums or portable tanks, employing a drip irrigation system or manual application.

Methods B and C would require vehicle access routes to the site for the 2- to 3-year watering period. Drip irrigation systems (methods A and C) and onsite storage drums or portable tanks (method C) could be reused at subsequent revegetation sites. To provide watering of windbreak regeneration sites entirely by onsite tanks, for example, six new 0.5-acre planting sites per year, irrigated for 2 years, would require procurement of 12 tanks.

Method A could be used where a water system hose bib is within a few hundred feet of a revegetation site and pressure is sufficient. Burying hoses to avoid vandalism will cause gradual hose deterioration and limit hose reuse at alternate sites.

Use of a single water delivery method throughout the forest should not be anticipated. The implementing forester should use a mix of systems as dictated by specific site needs.

Weed Maintenance. Removing weeds around seedlings is one of the most effective ways to increase survival rates and lengthen the interval between waterings.

Most weeds are shallow-rooted grasses and forbs that can extract water from the surface soils far more efficiently than tree seedlings. Once the available water is extracted, these weeds reproduce and die or become dormant. A seedling must extend its roots below the weed root zone before it can survive on its own.

Certain grasses also release chemical growth inhibitors to restrict competition (root growth) from other plants. Grass fires are also a constant threat to young seedlings.

Three methods of eliminating weeds are available: weeding by hand, applying herbicides, and rototilling. At the Presidio, hand weeding within 18 inches of seedlings should be the prevalent practice. However, when very aggressive weeds are present, such as kukuyu or Bermuda grasses, herbicide applications may be necessary. Timing of herbicide applications is extremely important to maximize their effectiveness and reduce usage.

Most weeds germinate in spring when the surface soil is moist and warm. By eliminating the weeds during this period, moisture competition will be prevented and well-rooted weeds will not have to be eradicated during summer. Hand weeding and rototilling are effective at this time.

Monitoring Seedling Growth and Survival

One of the most important vegetation maintenance tasks is monitoring seedling and sapling growth to evaluate plant vigor throughout the seasons.

Seedling Problems. Occasionally, poor planting stock may pass an initial health inspection and be planted throughout the Presidio forest. Monitoring should identify this problem, as well as poor planting techniques and mediocre performance by a particular experimental tree species.

Human Influences. Once a forest area is opened and access is provided, people will make use of it. Picnickers, joggers, hikers, bikers, and off-road vehicle users may create trails and damage seedlings. Tree theft may be a serious problem, especially before Christmas. Controlling human use would minimize damage to the site and seedlings.

Pests. Numerous animals, insects, and diseases can seriously injure or kill seedlings or attack mature trees. Some diseases, such as western gall rust, can infect a pine seedling, but the deformation will not be serious until the tree has senesced and becomes unhealthy, unsightly, or hazardous. The implementing forester should identify pests before they become epidemic. Revegetation maintenance crews should have a general knowledge of seedling physiology and stress-related symptoms.

Remedial Action for Seedling Losses

Damaged, defective, and poorly growing trees should be removed as soon as possible. Each reforestation area should be overplanted because of these potential problems. When a particular reforestation area has more than 50 percent mortality in a 3-year period, a seedling replacement program should be initiated.

Once the trees have completed their third season, they should be able to survive without irrigation or weeding.

Weak trees that have not been eliminated as seedlings will decline in vigor or be attacked by insects and diseases from the surrounding stands. Monitoring these trees during the spring and fall should be done to reveal whether a particular insect or disease pathogen could spread.

Although reforestation areas will no longer need watering and weeding, they will require thinning.

Thinning of Saplings

When a successful reforestation area becomes too crowded, competition for water and nutrients may develop between healthy trees, weakening them. Before this happens, usually between the ages of 5 and 7, some healthy trees may have to be cut down. Tree growth performance in relation to density should be monitored over time to determine the best tree spacings for specific species and site conditions.

The first trees to thin are those in the high-risk category. These trees usually display abnormal color, poor retention of the oldest foliage, or slow growth. The second cut should be to the poorly formed trees: those with double boles, oversized branches, or those that lean. The final cut, if necessary, should be done to space the trees so that the branches do not overlap. A spacing interval for trees at the Presidio can be calculated by adding 4 inches to the average tree diameter (at breast height) in inches, using the sum as the spacing, but with each inch equaling 1 foot on the ground (e.g., an 8-inch-diameter tree should be spaced 12 feet away from another similarly sized tree). Appearance, sunlight access, and the intent to increase forest diversity should also be considered in spacing decisions.

Treat stumps as discussed above under "Cutting and Preparation for Revegetation."

Developing a Mature Forest

After stands are thinned and are growing vigorously, other shrubs and forbs should be introduced into the stands identified in Chapter 5 (primarily Emphasis Areas 1, 4, and 7). In Emphasis Area 7 in particular, native shrubs providing wildlife food should be planted in the thinned areas.

A final thinning should be done to achieve desired spacing or to remove potentially hazardous trees before they grow out of the sapling stage; otherwise, very little maintenance should be done in these stands, except fire and erosion control.

Tree Pruning Methods

All landscape pruning should be directed by the implementing forester or a certified arborist contracted for this purpose. Most of the landscape trees on the Presidio have been inventoried and numbered. All pruning actions on a tree should be recorded in the inventory. In the event of future litigation, these records can help prove that a safe forest has been actively managed for.

Pruning Intensities

Before pruning is done, its purpose should be explicitly stated. Based on this purpose, one of the following pruning intensities should be adopted:

Light Pruning. The purpose of a light prune, or "safety" prune, is to remove identified hazards, such as cracked, broken, or hanging branches. The average time to perform this work varies from 1 to 2 hours per tree. Another hazard inspection should be made in 2 years.

Standard Pruning. The purpose of a standard prune is to remove hazards, as in light pruning, and to develop a safe and functional crown structure. The average time to perform this work varies from 4 to 6 hours per tree. Similar treatment should be repeated in 5 years.

Heavy Pruning. The purpose of a heavy prune is to provide the same treatments as a standard prune, as well as perform major structural work to preclude future hazards indicated by an unusual growth form. The practices of cabling, bracing, or removing major stems are not considered part of a heavy prune. A heavy prune requires 8-10 hours per tree on the average. Such tree work should be repeated in 10-20 years.

Pruning Practices

Pruning should employ the following practices for each of the intensity classes:

Light Pruning. The pruner should:

- o remove or repair the identified hazard;
- o remove hazardous branches;

- o remove weak, diseased, insect-infested, broken, low or crossing limbs; and
- o trim all suckers, shoots, and vines.

Standard Pruning. The pruner should:

- o remove dead wood and branches that have extremely narrow angles of attachment,
- o note and treat any structural weakness or decayed trunk or branches,
- o remove any mistletoe,
- o remove all loose bark hanging in eucalyptus crotches,
- o remove branches that have included bark (common with Monterey cypress),
- o encourage development of permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached,
- o eliminate narrow V-shaped branch forks that lack strength, and
- o maintain a natural appearance and crown balanced with roots.

Heavy Pruning. The pruner should:

- o provide vertical limb spacing from 18 to 48 inches wide and radial orientation of limbs so as not to overlay one another;
- o prune and shape trees as necessary to reduce forces;
- o prune tops when necessary to reduce tree size overall, but not more than 20 percent or lower than 15 feet (this does change the scaffolding structure of the tree), and
- o use the drop crotch method of pruning in conjunction with thinning cuts to reduce tree spread and height.

Providing Clearances

Proper vehicle clearance should be provided. This includes limiting the height of lower branches and the extension of branches into the street. Height clearance at the curb should be 14 feet from street level. Trim to give streetlights and signs a minimum of 6 feet of clearance. Trees with dense foliage surrounding streetlights should be opened to allow light to penetrate the head. Adequate clearance should be provided for pedestrians to walk under the tree without risk of personal injury.

Prune to provide adequate sight clearance at intersections and clearance of traffic control signs at intersections. Pruning around high-voltage transmission lines should be done by a qualified line clearance tree trimmer. Most electrical wires should be cleared by a minimum of 6 feet.

Best Pruning Practices for the Presidio

The preceding section described standard pruning practices. The following practices would optimize the results of pruning.

- o All trees should be pruned to replicate the natural growth of the tree. Follow the shape suggested by the natural growth habits of each tree species.
- o All pruning cuts should be made using the pruning methods of Shigo (1986).
- o The primary pruning of deciduous trees should be done during the dormant season, but damaged trees, or those that constitute health or safety hazards, may be pruned at any time of year, as required.
- o Under no circumstances should "stubbing" ever be performed.
- o All limbs 1 inch in diameter or over should be undercut to avoid splitting. The undercut should be at least one-third of the diameter. The second cut should be made 3 inches further from the crotch than the first. The final cut should be made near the crotch in a manner to favor the earliest possible covering of the wood by callous growth. This cut should be done by using the branch bark ridge and by following the branch collar. Cuts should not be made so large as to prevent normal sap flow.
- o On trees known to be diseased, pruning tools should be disinfected with a 10-percent chlorine bleach solution of sterilant after each cut, and the same process should be repeated before cutting another tree.
- o Cut laterals to preserve the natural form of the tree, leaving the head open enough for the branching system to show and permitting dead material to be easily cleaned out and light to show through the head. Tree foliage should not be reduced by more than 20 percent.
- o Pruning should be done with hand pruners where practical. Small limbs, including suckers and water sprouts, should be cut close to the trunk or branch from which they arise.
- o All cut branches 3.5 inches in diameter or larger should be lowered to the ground with ropes if damage to the lower tree branches is possible.
- o Cuts should not be painted.

- o All visible girdling roots should be treated and reported to the forester as a possible hazard.
- o In areas of high visual sensitivity, trees to be removed should have the stump ground down to 6 inches below grade to prevent tripping hazards and resprouting; elsewhere, stumps should be cut flush with ground level.

Woody Debris Disposal

Existing Practices

Most woody material, which includes tree branches, limbs, and trunks, should be moved to a central location and hauled away by a contract salvager. Small branches should be chipped and spread.

Planned Increase in Woody Debris

Woody debris has been increasing at the Presidio as the trees become over mature and fail. Volumes of woody debris will substantially increase with implementation of the reforestation program of this plan, and burying the debris at a landfill will no longer be feasible. Chapter 7 describes expected volumes of woody material and presents a recovery and utilization plan for this material. Some aspects of moving and chipping this material are described below.

Small Debris Removal. Small woody debris is created by normal tree pruning or when a tree is removed piece by piece. The size and structure of this debris make manual labor the most effective means of moving it from where it was cut to a site where it can be chipped or transported to a processing area. If a chipper or truck can get close to the trees, the cost of handling debris will be considerably reduced. If the material is chipped onsite and not transported elsewhere, costs will again be reduced. Hydraulic packing trucks are now being used in park systems to compress unchipped brushy material. The labor it takes to load brushy material and transport it into a packing truck is significantly reduced. Use of this equipment should be considered.

Large Debris Removal. To remove large woody debris, such as tree stems (logs), root wads, and large branches, methods similar to those used in rural logging should be used, except that in the urban environment more planning and resource protection are required.

A large, heavy-duty skidder, a winch truck, or a small farm tractor should be used to move logs and root wads offsite. The winch should be used in conjunction with the skidder or with a winch truck to move the woody debris to a roadside loading area. A small four-wheel-drive farm tractor does not have the pulling or winching power of the big skidder but, with additional labor, can move the tree in smaller pieces using the bucket loader to the truck. Large logs require specialized equipment, such as front-end loaders, to load them into heavy-duty dump trucks, log trucks, or flatbed trucks and transport them

to a storage yard where they can be sorted, reduced, retransferred and/or disposed of. Front-end loaders and tracked equipment should not be used to move logs appreciable distances. A full description of equipment recommended for use in moving large woody debris offsite is given in the "Stand Cutting" section above.

Chipping

A successful whole tree chipping operation will require a more powerful chipper than is currently in use at the Presidio, and trained personnel will be needed to operate and maintain it. Chipped foliage, when composted, provides an excellent amendment for the sandy soil. Wood chips can be used to inhibit the growth of weeds and undesirable vegetation at the reforestation sites. This practice also reduces watering costs, prevents erosion, and lowers fire potential. Wood chips can also be applied on pathways and roads to keep dust down, reduce soil compaction, and add to an attractive landscape.

Chipping can occur onsite or at a log storage yard. Onsite chipping is feasible only where clearing size exceeds 0.5 acre; smaller openings preclude adequate equipment mobility.

Chippers have several drawbacks in addition to their expense. Chippers inherently have mechanical problems and require regular maintenance. Embedded metal and rocks can severely damage them. Chippers are extremely noisy and require adequate noise muffling near residential areas. Personnel usually find it undesirable to work with a chipper.

Fire Protection

The concern for fire within the Presidio forest has had a major influence on past forest management practices. Practices described here are currently used by the Presidio staff and have prevented serious losses from wildfire.

Prevention, suppression, and rehabilitation are the three major stages of fire protection services.

Prevention

For both forest and structural fire protection, the most important stage is prevention, which begins with an understanding of fire history and present fire potential.

Fire History. Fire probably was used on the Presidio by the Spanish as a land-clearing tool and for keeping brush off of valuable pasture lands. The wildfires before the Presidio forest was planted were typically infrequent, but were fast-moving, high-intensity grass and brush fires. Studies in coastal Marin County found that before the 1900s, major fires occurred on an average of every 7 years (Cole pers. comm.). Natives or early settlers may have had an influence on this frequency.

Once the new forest was established, the danger of wildland fires was considerably lessened. The grass and brush fields were broken up with a fairly fire-resistant vegetation. The young trees shaded out most grasses and deposited very little burnable (dead) woody debris to enhance a fire. The young forest was an effective fire deterrent.

The resistance of the forest to fire has changed as it has grown older. The amount of fuel on the ground has increased, and in some stands where little fuel modification has occurred, the threat of fire has increased.

Wildfire Potential. The Presidio weather, the type and age of the vegetation, the topography, the design of fuel clearance around buildings, and the number of people using the area have a significant effect on fire potential. Prevention practices should address each of these elements.

Weather. The climate at the Presidio and San Francisco is very different from surrounding inland areas. During the summer it is usually cool when the valleys to the east and south are very warm or hot. The summer fog greatly reduces the potential for wildfires. However, for a few days during the late summer and fall, or "red flag days," the weather is no longer a fire suppressant but a contributor to a fire hazard.

In addition to causing cooler temperatures, fog directly contributes moisture to surface fuels through drip. This contribution considerably lessens the ignition potential for the Presidio's forest fuels. The taller trees comb water out of the fog and produce a nightly rainfall as the fog enters and leaves the city.

For about 10 days during late summer, fall, or early winter on the average, winds come from the east instead of the west. The usually moist fuels become very dry, resulting in a serious fire potential. At such periods, wildland fire agencies usually restrict forest uses until the weather changes. Such restrictions are more difficult to enforce in the Presidio's urban environment.

Vegetation. Forest vegetation has a large influence on the severity of fire hazard. Three aspects of vegetation character affect this hazard:

- o **Fuel Ladder Structure.** Fire usually starts on or near the ground and, to become a catastrophic event, a ladder of fuel is necessary to allow it to move from the ground to the tree crowns. A prevention practice currently used at the Presidio is the removal of ground fuels under the stand canopy by mowing, pruning, and keeping brush and weeds out of the stands.
- o **Fuel Loading.** As trees in a forest grow taller, they usually shed their shaded lower branches. Over time, a large amount of fuel can accumulate under the forest canopy. The fuel loading caused by seasonal branch drop at the Presidio has been recognized by staff, and the fuels are removed constantly.
- o **Species.** The eucalyptus stands, because of their high fuels loading and natural oils, can explode into a major fire.

Topography. A forest fire generally burns hot and rapidly upslope or in the direction of the wind. Structures located in natural chimneys, such as narrow canyons and saddles at the head of canyons, are especially fire prone because winds are funneled into these areas. In steep and narrow draws, radiating heat may also be a major factor in fire spread and structure losses. Buildings without adequate setbacks on narrow ridges are especially vulnerable.

Hazard Reduction through Structural Design. The primary concern of wildland fire protection at the Presidio is structural protection. The fire safety of a building depends on the continuity and loading of the fuels around it, the location of the building with respect to topography, and the design of the structure itself. Building density is also an important safety consideration because a burning structure can ignite adjacent structures.

Roofs. The roof is the most vulnerable part of a structure because it is exposed to airborne sparks. The wood shingle roof has been the single most important element in structural losses during wildland fires. It is also a major source of airborne firebrands capable of igniting nearby structures. Such roofs should not be used at the Presidio in the vicinity of forest stands.

Siding. Exterior materials used on structures near forest stands, such as stucco, metal siding, brick, concrete block, or rock, should have a fire-resistance rating of 1-2 hours. This is especially critical for parts of structures exposed to winds or positioned at the top of a slope. Fortunately, many of the Presidio's residences adjacent to forested areas are constructed of brick.

Structural Improvements. Several architectural design features can improve the fire safety of existing structures.

Hazard Reduction through Vegetation Maintenance. The landscape around buildings should provide natural beauty but not be a hindrance to their protection when there is a real threat of wildfire. Good initial planning and careful, regular maintenance is required around these structures.

Landscape maintenance is the best way to keep structures separated from surrounding vegetative fuels. The objective is to keep the amount of fuels at a safe level and to create a safety zone for residents, firefighters, and fire equipment.

For forest fire prevention purposes, the area around a structure should be divided into three zones of defense: 1) 0-30 feet - year-round maintenance; 2) 30-100 feet - seasonal maintenance; and 3) 100 feet or more - yearly inspections, periodic maintenance.

California Resource Code Section 4219 requires clearance of flammable vegetation for a minimum distance of 30-100 feet around any structure located in a fire hazard area. The clearance distance is subject of local police enforcement, and in extremely hazardous areas, local fire authorities may require clearance beyond 100 feet.

Maintenance Adjacent to Structures. The area within 30 feet of the structure is most critical for fire safety. Maintenance of nonflammable landscaping, such as lawns, border plantings, flower gardens, and vegetable beds, helps reduce fire hazard close to the

structure. Additionally, all leaves should be removed from roofs before the fire season begins.

Shrubs and trees are a necessary part of landscaping. However, these plants often become potential fuel. Eucalyptus trees usually contain a large amount of dead twigs, branchlets, and flammable oils. These conditions can produce high flames that can be deflected by wind onto the roofs of nearby structures. Oak trees are also noted for their tendency to spread fire.

30- to 100-Foot Zone. Seasonal fire maintenance in the 30- to 100-foot greenbelt zone around a structure should consist of removing dead woody plants, and occasional pruning of trees and shrubs. In thinning and pruning, care should be taken not to expose the soil surface excessively. Well-pruned, healthy shrubs require several years to build up an excess of flammable live and dead fuel. Therefore, thorough pruning can suffice for a long time.

Zone Beyond 100 Feet. The amount and continuity of vegetation should be controlled. Groups of young trees in the reforestation areas will divide the mature forest and create fuel breaks. This mosaic of forest vegetation will inhibit the spread of wildfire.

Suppression

When a fire occurs in the forest, special tools, equipment, and trained personnel should be available to suppress it.

Structural versus Wildland Suppression. Suppression of a wildland fire and suppression of a structural fire are fundamentally different. Suppression priorities are based on the value of property to be protected. A forest fire should usually be attacked only after the structures it is threatening are adequately protected.

Responding with Appropriate Personnel. The San Francisco Bay region does not have a constant threat of wildland fire; local training priorities reflect this fact. Wildland firefighting requires the use of different suppression strategies, as well as unique equipment and safety procedures. Fire personnel trained only in structural protection can not be effective in suppressing a serious wildland fire (e.g., a eucalyptus forest fire) and can be endangered by attempting to do so.

Cooperative Agreements. All fire departments have cooperative agreements with adjacent fire departments to handle a serious structural conflagration. The Presidio fire department should contract with wildland fire suppression agencies, such as Marin County fire departments, East Bay Regional Parks, and the California Department of Forestry and Fire Protection, for training, equipment sharing, and suppression assistance.

Rehabilitation

Depending on the severity of the fire and the vegetation burned, rehabilitating a burned area can be very expensive. A fire should be suppressed in the urban area because

of the threat to structures and people, but the damage to the environment by suppression forces can be very significant.

Once a fire has removed the vegetative cover, erosion should be expected to occur the following winter. Use of the measures detailed in the "Erosion Control" section, such as grass-seeding and mulching, will be needed.

Fire is a natural way to encourage reproduction of many of the tree species in the Presidio. Unfortunately, the first plants to largely occupy burned sites are usually undesirable weed species, such as scotch broom. Moreover, experience with forest fires on Angel Island has shown that after a fire, eucalyptus sprouting can result in an even more serious fire hazard within a 3-year period. Other tree species and certain grassland and brushland communities also exhibit similar behavior. Accordingly, rehabilitation after each serious wildland fire should be carefully planned to ensure the recovery of desirable vegetation.

Erosion Control

Erosion is a continuing problem at the Presidio, primarily because of the sandy texture of the substrate and the frequent severity of winds and rainfall. Human use of the site results in the concentration of runoff, which can cause gullies in the Presidio's sandy soils. Dune soils in the forested areas where the slope is appreciable and where ground cover is absent gully easily during and after precipitation.

Reforestation activities usually involve substantial soil disturbance and the development of large area of compacted soil. Disturbance can result in scouring runoff and soil erosion. Because of the magnitude of potential problems, careful consideration should be given to the hydrologic impact of revegetation activities during the planning stage.

Soil erosion is influenced by climate, geology, topography, soil type, and vegetative cover. The following explanation of these processes will provide some understanding of the problems involved and possible solutions at the Presidio.

Types of Erosion

Soil erosion is a natural process caused by wind, water, and gravitational forces. A disturbance of the natural soil mantle of overlying vegetation leads to accelerated erosion, which may progress at rates thousands of times faster than natural erosion. The forms of erosion affecting reforestation and other forest management activities on the Presidio are wind, sheet, and rill and gully erosion; mass movement (landsliding) also occurs here.

Wind Erosion. Wind erosion occurs when ground cover is removed from the stabilized sand dunes exposed directly to the wind. Large volumes of sandy soils may be displaced by wind on exposed sites, and restabilization of these dune sands is often extremely difficult and expensive.

Water Erosion. Sheet erosion is caused by the impact of raindrops and the sheet flow of runoff water. This energy is normally dissipated by vegetation, but when the soil surface is exposed, soil particles are displaced and moved downslope. Sheet erosion washes away a thin, uniform surface layer of soil. For this reason, the process may be difficult to recognize.

Rill and Gully Erosion. These erosion forms are caused by downslope movement of runoff water in numerous small channels parallel to the slope. Rills form in the upper areas, and large gullies lead into stream channels on the lower slopes. Acting on relatively unprotected soil, runoff generated on slopes of greater than 1-15 percent may cause serious gully erosion. Once large gullies are formed, control becomes extremely difficult.

Mass Movement. Mass movement or landslides occur as the result of gravitational influences and internal structural failure caused by weathering, undercutting of the slope, or earthquakes. Areas adjacent to the cliffs near the ocean are being undercut constantly by wave action, and a major active fault is just offshore. Other areas of the Presidio are considered relatively stable, but some local failures could occur during a major earthquake.

Presidio Erosion Factors

Climate. Climate exerts a major influence on erosion rates, which are relatively high in the coastal areas of California.

Erosion rates are high in this area of relatively low rainfall for several reasons:

- o Erosion rates are closely related to vegetative density. Low rainfall produces less vegetative cover; therefore, more soil is exposed to the forces of erosion.
- o In Mediterranean climates, most rainfall occurs during winter when temperatures are too low for rapid vegetative growth.
- o Although total rainfall is relatively low, maximum rainfall intensity is relatively high.

Rainfall intensity is often more important than total rainfall in influencing erosion rates.

These conditions not only have an influence on natural erosion rates but greatly affect erosion in disturbed areas and may hamper revegetation efforts.

Soils. Sandy soil, as found in the Presidio, is highly erodible but has a high infiltration capacity. In contrast, clay soils have a low infiltration capacity and produce high runoff, but they do not erode rapidly. Mass movement is also related to soil type but is strongly influenced by vegetative cover, underlying material, slope, and subdrainage.

Topography. The topography of the Presidio varies considerably. It ranges from level or gently rolling with few steep drainages to steep with slopes sometimes exceeding

50 percent. Erosion rates rise disproportionately with slope; steep slopes are highly erodible.

Vegetation. Vegetation reduces erosion and runoff in several ways, including: 1) protecting the soil from the direct impact of raindrops and surface flow; 2) decreasing runoff by increasing infiltration and percolation capacity of the soil; 3) holding the soil in place with roots; 4) and contributing dead leaves, twigs, limbs and other vegetative matter that produce litter and humus to protect the soil surface and provide additional water storage capacity.

Vegetative cover found on the Presidio varies from dense forests with heavy understory to a sparse cover of annual grasses and forbs. The ability of vegetation to protect the soil from erosion increases as density and root depth increase. Heavy forest provides the best protection from erosion, brushlands provide intermediate protection, and sparse grassland provides minimum protection.

A special problem exists in the windbreak forest that was planted to stabilize the Presidio's sand dunes. The mature forest canopy provides too much shade for an understory to survive. Consequently, the rainfall has eroded a series of gullies on slopes over 15 percent; some gullies are up to 4 feet deep. Wind erosion has been reduced by afforestation, but water erosion has greatly increased because of human influences.

Erosion Control Practices

Forest regeneration activities will cause significant soil disturbance, and mitigation measures should be adopted to prevent unacceptable soil losses or offsite damage.

Access Trails. Access trail standards should be developed to minimize excavation. Trail layout and design should take into account substrate, topographic, and vegetative characteristics. As a general rule, steep grades should be avoided, and any drainage disturbance should be minimized. Effective drainage is probably the most important consideration in trail design construction. It is imperative that effective drainage be provided at all points of runoff concentration caused by trail construction.

Water bars (also known as "drain dips"), a combination of a ditch and a mound built diagonally across the trail to direct sheetflow off the surface (passable by vehicle), should be used on all unpaved skid trails. Water bar spacing should not exceed 50 feet.

When access trails are no longer needed for seedling maintenance (generally after 2-3 years of watering), they should be abandoned. Vehicular access to the trails should be obstructed and pedestrian use discouraged. Trails on appreciable slopes or very sandy soils should be planted with grasses and straw-mulched or covered with chips as described below.

Forest Regeneration Areas. The following steps should be taken to prevent accelerated erosion in reforestation areas.

Minimize Area Disturbed. Leave as much of the site undisturbed as possible. Funnel disturbance to specified areas. Leave vegetation that will not interfere or compete

with the new trees on the site. Minimize disturbance of dune sands and other highly erodible areas.

Stockpile Disturbed Soil. During skidding or excavation, stockpile acquired topsoil for later reapplication. Topsoil contains seeds of many shrubs, herbs, and grasses that will help provide vegetation growth.

Use Woody Debris. On steeper ground, lay the large and small woody debris across the slope and in continuous contact with the surface.

Use Native Vegetation. Native grasses and other native vegetation require the least care of any planting materials. Certain species, such as lupine, can grow well on disturbed sites. During regeneration of dune windbreaks, plant native coastal scrub species and/or prairie grasses between more widely spaced trees.

Plant and Mulch Grass Cover. At highly erodible sites or sites with high erosion potential, plant a grass seed mixture on all exposed soils for temporary protection. Use either Zorro Annual Fescue on dry sandy sites, or Blando Brome where soil is deeper, with native grasses, if possible. Ryegrass is not an adequate substitute. Scatter seed by hand at the rate of one-half pound per 1,000 square feet. Unless irrigation water is available, seeding should occur in the fall.

On slopes steeper than 30 percent, use excelsior netting to hold the straw and seed. Consider hydromulching for large, steep areas. All mulches will provide some degree of erosion control, moisture conservation, and weed control. Note that the various kinds of mulch include straws or wood chips, hydromulch, rock surfacing, mats, and nets.

Mulch with wood chips and two 100-pound bales of straw per 1,000 square feet. On slopes over 15 percent, punch straw into soil with a roller designed for this purpose.

Control Water Runoff. Direct water runoff away from erodible areas and into natural swales. If drainages are not available, direct runoff onto paved areas, grassy waterways, well-vegetated areas, or other downstream areas not prone to erosion.

Monitoring Erosion Processes

The best method to monitor erosion is to be onsite during significant rainstorms and observe the erosional processes at work. The performance of erosion control measures should always be observed during the first rainy period after application. Performance observations should lead to amending or supplementing erosion control measures.

Cultural Resource Protection

Whenever subsurface artifacts are discovered or suspected in an area, all activities that could threaten to damage them should be suspended. A qualified archeologist should

work in consultation with the State Historic Preservation Officer in formulating a mitigation plan to protect cultural resources.

If any tree removal requires the alteration of the exterior of any identified historical structure, Presidio Master Plan provisions for such structures should be complied with.

The special treatment of historical forest stands and entryway plantings at the Presidio, as described in Chapter 5, is intended to preserve these historical resources as long as possible. These treatments should be aggressively implemented. If the State Historic Preservation Officer and the Advisory Council on Historic Preservation determine that the original forest stands are a significant contributing element of the National Historic Landmark and Historic District of the Presidio, more stringent preservation and reforestation measures may be warranted. Such measures would be enumerated in a Memorandum of Agreement signed by all responsible parties.

Chapter 7. Recovery and Utilization of Wood Resources

Current Tree Removal and Wood Utilization

Tree removal at the Presidio is restricted to trees that have fallen during storms, and dead or dying standing trees. Removal work is performed by the 19 employees of the base grounds maintenance staff. Nearly all trees removed from the Presidio are hauled in log form to a central storage yard comprising approximately 1 acre in the Fort Scott area. Logs are deposited there into debris boxes owned by a private vendor who periodically removes full boxes and replaces them with empty ones.

Portable wood chippers are occasionally rented for in-woods use on the base. The resulting chips are usually distributed onsite for landscaping or erosion control purposes. The Presidio does not currently stockpile chips for onsite use; pine bark chips are purchased for mulching and other landscaping uses (Straub pers. comm.).

A timber sale agreement between the Presidio and an independent logger/firewood operator was entered into following adoption of the 1984 forest management plan (McBride 1984). For most of the approximately 18 months during which this agreement was in effect, the contractor produced firewood which was subsequently marketed off-base. Prior to the default of the agreement, the contractor hauled logs to a biomass energy facility in Antioch, California where they were ground into fuel and burned.

Projected Tree Removal

Harvesting Systems and Techniques

This forest management plan recommends implementation of a reforestation program that would substantially accelerate tree removal on the Presidio relative to current rates. Trees to be removed are mainly those that display low vigor, and, in particular, those low-vigor trees that pose risks to people or property or that serve as important windbreaks. Additional removals will occur in areas designated for restoration of native habitat or for visual enhancement.

Removal activities involve trees within forest stands (in areas designated as Management Emphases 1-7) and trees standing individually or in small clumps in the vicinity of structures and other developed sites (in areas designated as Management Emphasis 8). As described in Chapter 5 in the emphasis area treatments, trees should generally be harvested using the single-tree selection method or the group selection method. As indicated by their names, the individual and group selection methods differ with regard to the number of trees removed from specific locations.

Group selection is usually recommended where forest regeneration is an objective, since successful regeneration requires creation of openings large enough to expose seedlings to direct sunlight. Single-tree selections are recommended primarily for salvage operations where regeneration is not an objective and in areas (such as Management Emphasis 8, "Hazards and Landscaping") where trees are widely spaced. For Management Emphasis 6, "Control Tree Topping," where vegetation conversion is an objective, strip cuts up to 2 acres are recommended.

All tree falling on the Presidio should be done with chainsaws. Mechanized harvesting equipment (e.g., feller-bunchers) are inappropriate for use on the Presidio because of the small size of proposed harvest areas and the relatively steep terrain. Where the harvesting of trees is not complicated by adjacent structures, roads, utility lines, or other trees, trees can simply be severed near the ground in a manner similar to that used in conventional commercial logging. For trees of average size for the Presidio (18 inches in diameter at breast height), a skilled logger can expect to fall, buck into sections, and limb up to 25 trees per day (Howard pers. comm.). This production rate corresponds to an average cost of approximately \$20 per tree. It applies only to portions of areas designated for group selection. Because of the hazards imposed by adjacent trees, the first trees harvested within each group selection area need to be topped before being cut down.

Special harvesting techniques need to be used wherever nearby structures or property could be damaged by falling trees, or where adjacent trees could "hang" a partially fallen tree. In most urban settings, trees must be topped before they are felled. The faller must climb the tree, attach lines to its top, sever and gradually lower the top. In many cases, the entire tree must be cut down and lowered in sections. Such tree work usually requires a crew of three and is particularly dangerous, especially for the faller. Per-tree falling costs using these techniques range from approximately \$320 for a simple topping situation, to more than \$1,000 for a difficult, multiple-section falling task (Howard, Lyons pers. comms.). Costs in this range would apply to most hazard tree removal and some historical stand or screen treatment.

Wood Collection and Processing

In-woods processing consists minimally of removing tree limbs and unutilizable tops. This material should be chipped onsite with a portable chipper and distributed nearby for soil enrichment, erosion control, or mulching of seedlings. In some cases, entire stems can be skidded or winched out of the woods for loading onto a truck. In other cases where moving long logs is likely to result in damaging collisions with standing trees, logs need to be bucked into sections before being moved.

Once out of the woods, logs are loaded onto trucks for hauling either to a centralized storage yard on the Presidio, or directly to a wood processing plant. Assuming equipment costs of \$60 per hour for the skidder, loader, and truck; labor costs of \$90 per hour for a three-person crew; and a production rate of 12 trees per hour, average total costs of skidding, loading and hauling (to a yard on the Presidio) are estimated at approximately \$12 per tree. Collection costs could be reduced in some areas by skidding logs directly down lightly used roads to a storage yard. Skidders would have to be followed by a safety vehicle to prevent collisions and to collect woody debris.

Wood Utilization

Market Uses

Wood removed from the Presidio could potentially be processed into four market products: sawlogs, pulpchips, firewood, and energy fuel.

Sawlogs. The Monterey cypress stands on the Presidio contain some of the tallest and straightest trees of this species found anywhere. These qualities make the Presidio's cypress trees particularly desirable as sawlogs or peeler logs for conversion into lumber or veneer, respectively. Although Monterey cypress is not widely used for lumber manufacturing in California, it has been marketed as a specialty wood, based in part on its light coloration and other attractive characteristics (Staub pers. comm.).

Several small sawmills located in coastal California have expressed an interest in purchasing cypress logs from the Presidio (Blevins, Murphy, and Staub pers. comms.) In contrast, none of the large sawmills contacted expressed such interest (Stone and Taylor pers. comms.). One mill is currently paying \$200 per thousand board feet (MBF) for Douglas-fir logs, which the purchaser considers to be similar in value to Monterey cypress (Blevins pers. comm.).

Constraints that could limit the feasibility of marketing sawlogs from the Presidio include the need to sell a sufficient volume of logs to make lumber marketing cost-effective, and the presence of rot and other defects in the cypress trees. To make sawlog sales commercially feasible, at least 100 MBF would need to be offered for sale at a time (Staub pers. comm.). The most common source of defect in Monterey cypress is brown cubical rot, which affects stems and branches (Herman Zillgens Associates 1988).

Other species available for harvesting from the Presidio in volumes sufficient to be of commercial significance, i.e., blue gum and Monterey pine, do not appear to be merchantable for lumber or veneer production.

Pulpwood. Wood from the Presidio could be used in the manufacture of wood pulp. Pulping requires the use of high quality chips, i.e., chips of uniform size; free of rot, dirt, and other contaminants; and with bark content no greater than 0.5 percent (Burk pers. comm.). In-woods chippers are frequently incapable of producing chips meeting these standards. Pulp chip production at the Presidio would probably require hauling logs to a storage yard; chipping them there using a large, stationary chipper designed for pulp chipping; loading chips into large vans; and shipping the chips to either a pulp mill or a transshipment point.

Potential pulp chip markets for wood from the Presidio include Gaylord Container Corporation at Antioch and two wood product export firms located at the Port of Sacramento. Of the tree species expected to yield commercially significant volumes of wood from the post, pulp chip market interest focuses primarily on blue gum. Due to continuous expansion of worldwide paper products consumption, and to the highly desirable pulping characteristics of eucalyptus, demand for eucalyptus pulp has increased rapidly in recent years, and is expected to continue to do so (Slinn 1987). Local demand for eucalyptus chips fluctuates, however, subject to short-term changes in orders, production

rates, and chip inventories. Eucalyptus pulp chips delivered to Antioch are expected to sell in the near future for approximately \$65 per bone dry unit (BDU) (Morgan pers. comm.). (One BDU equals 2,400 bone dry pounds or 1.2 bone dry tons.)

Monterey pine chips also have the potential to supply pulp markets. Pine chips of pulping quality sell at the Port of Sacramento for approximately \$22.50 per green ton (Burk pers. comm.). This green wood price corresponds to a price ranging from \$54 to \$68 per BDU, depending on average wood moisture content.

Firewood. The managers of the Presidio have recently had experience administering wood sales for firewood production. The contract to remove fallen or high-hazard trees and process them into firewood encountered significant problems that culminated in default of the contract (Straub pers. comm.). These problems included the disruption of normal Presidio activities resulting from onsite firewood processing, the relatively low popularity of firewood from the tree species available on the Presidio, and the need to market firewood in small units within the San Francisco area.

Cords of firewood sell for up to \$200 in San Francisco. Most firewood consumed there is purchased in smaller units, however. Boxed wood is sold at most supermarkets in 1.0 cubic foot units for approximately \$5, and in 1.5 cubic foot units for approximately \$6, corresponding to a per-cord price range of \$320-400. Storing more than a few cubic feet of firewood would be a problem in many San Francisco households.

Firewood from native oaks is considered most desirable by most users; eucalyptus wood, however, is comparable to oak in heat content. A leading impediment to the marketing of eucalyptus firewood is purchasers' lack of familiarity with eucalyptus. Softwoods such as pine and cypress produce less heat per unit than hardwoods such as oaks or eucalyptus, and consequently sell at a discount.

After logs have been hauled to a storage yard on the post, they need to be bucked and split into pieces of convenient size for home use. Bucking, splitting, and stacking are estimated to cost approximately \$25 per cord (Reynolds pers. comm.). Following processing, firewood is usually seasoned by storing it for 3-6 months. Seasoned firewood could be marketed through retail sales at the storage yard, at another location on the Presidio, or at firewood lots located elsewhere in the Bay Area.

Access to efficient marketing channels is essential to profitable firewood sales, as evidenced by the default of the recent Presidio firewood contract and by the low prices paid to the City of San Francisco by local firewood operators for wood delivered to the storage yard at Golden Gate Park. The most any operator has agreed to pay the city for delivered logs is approximately \$3 per cord (Smith, Stephen pers. comm.). Considering the high retail prices for firewood in San Francisco and the low transport costs associated with a local wood supply, however, firewood sales from the Presidio could become a significant source of revenue. Finding contractors with the skill and sensitivity needed to produce wood without unduly disturbing the Presidio's environment, residents, visitors, or neighbors, and who would be able to harvest, process, and market firewood efficiently, is expected to be difficult (Nicoles pers. comm.).

Fuelwood. Wood is in increasing demand as fuel for generating electricity. Over 420 megawatts of electrical capacity operating on biomass fuels have been installed in California over the past 10 years (Magaletti pers. comm.). Wood residues from sawmills

and other wood processing facilities were traditionally the lowest cost source of wood for powerplants, but, because of expanded cogeneration and market electricity sales by wood processors, sawmill residues have become increasingly scarce. As a result, marketing of forest resources for biomass fuels is increasingly feasible.

Logs are usually ground, rather than chipped, into fuel. Fuelwood product standards are lower than those for pulp chips; both portable chippers and stationary chipper/grinders produce products suitable for burning in biomass plants. Gaylord Container Corporation currently pays approximately \$23 per bone dry ton (BDT) for wood fuel delivered to Antioch (Morgan pers. comm.). Prices for fuelwood are expected to increase over the short term in the Sacramento area as new wood-burning power plants come on line in Rocklin, Williams, and Woodland (Burk pers. comm.).

Erosion Control and Landscaping Uses

The Presidio has a large capacity for using woodchips in erosion control and landscaping projects. This capacity will increase in proportion to the level of the reforestation program implemented in the future. Using wood chips for erosion control and landscaping would reduce soil erosion, conserve irrigation water, inhibit weed competition and increase the success of tree planting, and improve the appearance of logging sites. Using chips from trees growing on the post would reduce costs relative to the current practices of buying similar materials for landscaping uses and paying a private refuse company to dispose of waste wood.

Two approaches are available for using wood chips produced on the Presidio for landscaping. The first approach involves chipping and distributing wood in the immediate vicinity of the logging site. This approach could be implemented in conjunction with a wood marketing program whereby the main stems of harvested trees are removed for marketing, while the unmerchantable tops and branches are chipped and used for site enhancement. If the tree's stem is unmerchantable due, for example, to its species or defect content, the entire tree could be chipped and distributed onsite. Chips can be used as a ground cover to stabilize areas of exposed or disturbed soil, and can be placed around seedlings to reduce evaporation from soil surrounding the plant's roots.

The second approach involves hauling logs from harvest sites to the storage yard, chipping the logs and storing the chips at the yard, and then transporting the chips to areas where and when they are needed. This approach is substantially more costly than the first approach, but it provides chips for landscaping use at areas other than active logging sites. Placing much of these chips in existing dune stabilization windbreaks (Emphasis 4c) devoid of ground cover would prove very beneficial.

Assuming a crew of two operates a portable chipper at a total cost for labor, machinery, and fuel of \$55 per hour, in-woods chipping and distribution are estimated to cost the equivalent of \$30 per BDT, exclusive of tree falling costs. Under the second approach, skidding and hauling logs to the storage yard and chipping them there using a stationary chipper is expected to cost approximately \$27 per BDT. Redistributing chips under the second approach is expected to cost an additional \$50 per BDT, however, for a total cost of \$77 per BDT. Onsite use of chips thus represents a savings of \$47 per BDT relative to the approach involving centralized collection and redistribution.

To compare the value of chips at the storage yard for landscaping use versus market use, consider that the chips would receive a minimum price of \$23 per BDT (the fuelwood price), less a round-trip hauling cost of approximately \$11 from the Presidio to Antioch, for a net market value of \$12 per BDT at the storage yard. Marketing chips would thus result in a net savings of at least \$62 per BDT, primarily by avoiding the \$50 cost of redistributing chips. This analysis does not, however, consider the substantial erosion control and landscaping benefits the chips can provide.

Recovery and Utilization Plan

Management, Pruning, and Salvage by Base Personnel

This plan recommends that the forest-management capabilities of the Presidio's grounds maintenance staff be increased by hiring a base forester, redefining job descriptions of some personnel, and establishing a structured forestry training program for selected staff. By implementing these recommendations, the maintenance staff could retain primary responsibility for removing fallen trees and some high-hazard trees. The base forestry staff could also take on responsibility for conducting much of the tree pruning called for by the plan.

Stand Cutting by Contractor

The tree harvesting and removal programs recommended by this plan represent a substantial expansion of these operations relative to their current levels. The increased workload could probably be accomplished most cost-efficiently by contracting with a private operator or operators selected through a competitive bidding procedure. Contract provisions should explicitly specify the amounts, locations, and timing of required tree harvesting; standards for removing woody material from logging sites and from the base; and standards for restoring logged areas.

Contract administration costs borne by the U.S. Army are likely to be minimized by selecting a single logging operator with the expertise and equipment required to accomplish all proposed logging and tree removal tasks in forest stands. The selected operator would be responsible for falling and removing specified trees irrespective of species or intended product market. The alternative approach of assigning different contractors responsibility for handling firewood and pulpwood operations, for example, would unnecessarily complicate contract administration. Furthermore, under the recommended approach the contractor would be responsible for offsite marketing of woody material, thus freeing the Army of the risks of fluctuations in wood-products markets.

Hazard Tree Treatments by Contractor

Tree removals recommended by this plan can be classified as either forest stand operations or arboricultural treatments. Arboricultural treatments, especially removals of hazard trees from landscaped areas, require specialized expertise and equipment possessed by few traditional logging contractors. A tree-service firm should thus be contracted with

independently of the logger hired to operate in the Presidio's forest stands. This firm would have responsibility for tree removal and debris disposal in Management Emphasis 8 (hazards and landscaping) and for other required specialized arboricultural services, including pruning of large trees, topping, and bracing. Depending on piece size and quality, hazard tree wood removals could be disposed of either for market or landscaping uses as described under "Wood Utilization."

Recommended Contract Periods

This plan proposes that forestry operations be conducted on an ongoing basis featuring a relatively intensive reforestation schedule over the next 20 years to improve the vigor and diversity of those forest stands at high risk because of advanced age. Tree removal and planting activities would decline somewhat in subsequent decades as maintenance supersedes reforestation as the primary focus of the forest management program.

Plan implementation would probably benefit if selected contractors were allowed to operate for several successive years, as opposed to annual replacement by a new contractor. On the other hand, contracts written to apply for longer than 5 years could engender a low level of motivation in the contractor, make it difficult to respond to unforeseen developments, and invite claims of favoritism or anti-competitive behavior on the part of the Army by competing operators or the public. To capture the benefits but avoid the problems of multiyear service agreements, this plan recommends that contracts for tree removal and arboricultural services apply for 3-5 years, subject to cancellation at the end of each year for failure to meet explicit, rigorous performance standards. At the end of each contract period, competing proposals would again be solicited.

Planting and maintenance of seedlings is also expected to be accomplished most cost-efficiently through service agreements with private contractors or nonprofit organizations. Various youth conservation corps, for example, have been conducting reforestation work in the San Francisco Bay area for several years. Such organizations are committed to providing low-cost, labor-intensive resource conservation services, primarily to public agencies, while also providing on-the-job training to young workers. Because the skills and equipment required for reforestation work differ greatly from those needed for tree removal work, separate contracts would probably be needed to implement these two aspects of this plan. As an alternative to contracting, reforestation work could be undertaken by the PSF grounds maintenance staff.

The ultimate objective of tree planting in harvested areas of the Presidio is not to replace mature trees with seedlings in the short term as much as to replace decadent forest stands with vigorous stands in the long term. Consequently, the Army should consider entering into long-term "stewardship" contracts with reforestation organizations whereby the contractor would be responsible not only for planting live seedlings at a predetermined spacing, but also for maintaining seedlings until they grow to sapling size and thus become relatively likely to reach maturity. Regardless of their specific terms, all reforestation contracts should establish explicit performance standards, provide for inspections to ensure that such standards are met, and should withhold partial payment for reforestation services until compliance with performance standards has been verified.

Chapter 8. Program Implementation

Introduction

This chapter provides guidelines for implementing the forest management plan by describing the recommended ("full implementation") program and two alternative programs ("partial implementation" and "minimum implementation"). These three program levels, outlined in Table 8-1, help define the range of forest management intensities that could be implemented at the Presidio. They define a range from the full implementation program defined in Chapter 5 to a program aimed only at maintaining the base's trees in a condition that would not endanger the safety of people using the grounds.

Any combination of emphasis activities between those of the full and minimum programs could be selected, once funding levels are determined. Cost and revenue data are presented by emphasis area in this chapter to facilitate a selection process.

All work under the three alternative program levels is assumed to be supplemental to the Presidio's current grounds maintenance program.

Following the description of program levels, this chapter also presents an identification of staff and equipment needs to implement the plan, and an analysis of sources of implementation funding and other assistance.

Program Levels

Full Implementation Program

Theme and Activities. Full implementation of the recommended forest plan entails use of the comprehensive program presented in Chapter 5 to implement each of the Forest Management Goals and Guiding Policies within the 20-year planning period.

This program involves a major landscape-tree hazard reduction program and the regeneration within 20 years of every Presidio windbreak that exhibits low vigor. Additionally, this program includes historical stand treatments, native vegetation restoration and maintenance, screen development and maintenance, vista enhancement, control of tree topping, wildlife habitat and diversity development, and control of all significant erosion within the planning period (Table 8-1).

Full plan implementation would allow the forest to be maintained beyond the planning period in a relatively high-vigor condition through a maintenance program costing significantly less than that required over the initial 20 years.

Table 8-1. Implementation Programs

Emphasis	Program Levels		
	Minimum Program	Partial Program	Full Program
1. Windbreaks	Regenerate portions hazardous to persons/property: estimated 5% of total within 20 years (0.3 ac/yr). ^a	Same as "Full Program."	On scheduled basis, regenerate all currently "low" vigor stands, or 50% of total, within 20 years (average 3.1 ac/yr). ^a
2. Historical plantings	No special management; treat stands as "Windbreaks" above.	No special management; treat stands as "Windbreaks" above.	Perpetuate stands as long as possible through sanitation cuts and soil treatment; when necessary, regenerate as "Windbreaks" above. Estimated regeneration: 40% within 20 years.
3. Native vegetation	None. (Allow qualified groups to maintain or restore, subject to implementation plan approval.)	Same as "Minimum Program."	Treat invasive plants in all maintenance areas (m) every 5 years. Restore all proposed areas (r) within 20 years.
4. Screens	Treat hazard trees only; treat existing 4a and 4b screens as "Hazards and Landscaping" below; treat existing 4c screens as "Windbreaks" above. Create no new screens.	Maintain existing screens through sanitation cuts. Schedule regeneration of 4a and 4b screens, and 25% of 4c screens, within 20 years. Create no new screens.	Maintain existing screens through sanitation cuts. Schedule regeneration of 4a and 4b screens, and 25% of 4c screens, within 20 years. Create all new 4a and 4b screens within 10 years, and new 4c screens within 20 years.
5. View enhancement	None; treat stands as "Windbreaks" above.	None; treat stands as "Windbreaks" above.	Initiate enhancement of both sites within 5 years; complete within 20 years.
6. Control tree topping	Disallow tree topping. Treat stands as "Windbreaks" above.	Same as "Full Program".	Initiate conversion to low-stature forest within 2 years; complete fifth cut within 20 years. Finance through tree topping fee. ^b
7. Diversity and habitat	No special management; treat stands as "Windbreaks" above.	No special management; treat stands as "Windbreaks" above.	Current forest: regenerate or diversify as needs arise; treat an estimated 30% within 20 years. Openings: afforest 20% within 20 years.
8. Hazards and landscaping	Same as "Full Program".	Same as "Full Program."	Prune or replace all priority hazardous trees within estimated failure period (600 per 5 years or average 120 trees/yr).

^a Assumes no major outbreak of insects or disease. The rate of regeneration should increase if insect or disease epidemic occurs.

^b In response to tree topping request by adjoining landowners, assess fee for each tree. Use fees to fund conversion program.

Forest management activities and costs of the full implementation program are summarized in Table 8-2. The plan calls for removing an average of approximately 1,500 trees per year over the next 20 years. Most of these trees (about 1,000 per year) would be removed through regeneration harvests using the group selection method; the remainder of the removals would be by salvage operations employing single tree selection. Tree planting would be as described in the treatments for each management emphasis in Chapter 5. Weed suppression and irrigation costs would be incurred until the seedlings reached the sapling stage, that is, through approximately three growing seasons.

In addition to tree removal and reforestation, the full program involves costs for the following activities:

- o planting and maintaining shrubs or grasses in Emphasis Areas 3 (native vegetation), 4a and b (visual and windbreak screens), and 7 (vegetation diversity and habitat enhancement areas);
- o protection, weeding, and expansion of existing native vegetation areas in Emphasis Areas 3 and 5 (vistapoint enhancement areas);
- o pruning of hazardous limbs (in addition to the pruning that normally occurs under current management) in Emphasis Area 4c (visual screen, windbreak, and golf ball barriers);
- o stump grinding in Emphasis Area 1b (landscaped windbreaks); and
- o erosion control (in addition to distributing wood chips on logging sites) in Emphasis Area 1c (dune stabilization windbreaks) and at other significant erosion sites.

Yield. The full implementation program would result in an average wood yield of approximately 97 thousand cubic feet (MCF) per year. This yield comprises 273 thousand board feet (MBF) of cypress sawlogs and 915 bone-dry units (BDU) of pulpwood and energy wood. Because of bark, unusable wood, sawdust, and other losses, 1 cubic foot of wood from typical trees on the Presidio would produce approximately 6.5 board feet of lumber.

Costs and Revenues. As shown in Table 8-2, the full program would require annual appropriations exceeding the current funding level by approximately \$539,000. A total of \$370,000 would be spent annually on tree removal, including \$253,000 for removing trees from forest stands and \$117,000 for removing hazardous trees from landscaped areas. Logging site restoration, including chipping of tops and branches, would cost \$44,000. Other costs, primarily for tree planting and maintenance, would total \$124,000 per year.

Sales of wood products delivered to a centralized storage yard on the Presidio, as described in the preceding chapter, are expected to produce revenues of \$89,000 per year. Net costs of implementing the full program would therefore total approximately \$450,100 annually.

Table 8-2. Wood Volumes and Annual Costs of the Full Implementation Program

Management Emphasis	Acres	Trees Removed Annually	Annual Volume Removed (1,000 cubic feet)					Annual Costs				
			Cypress	Eucalyptus	Pine and Other	Total	Annual Revenue	Tree Removal	Slash Disposal	Planting and Maintenance Trees	Shrubs	Total Net Cost
1a. Windbreak	136.9	412	13.8	15.8	0.8	30.4	\$32,400	\$45,900	\$11,600	\$19,300	\$0	\$76,800
1b. Windbreak - landscaped	38.9	26	1.6	0.2	0.8	2.6	\$3,600	\$8,400	\$4,100	\$2,500	\$0	\$15,000
1c. Windbreak - dune stabilization	27.5	128	0.4	0.0	5.7	6.1	\$3,800	\$10,000	\$2,600	\$6,400	\$0	\$19,000
2a. Original plantings - windbreak (a)	37.3	164	8.6	8.8	0.1	17.5	\$10,700	\$38,100	\$4,600	\$3,900	\$0	\$46,600
2b. Original plantings - entryway	9.5	15	0.2	0.6	0.0	0.8	\$600	\$1,700	\$400	\$1,500	\$0	\$3,600
3. Native vegetation	106.2	117	2.5	2.5	1.4	6.4	\$5,400	\$12,100	\$3,300	\$11,400	\$8,000	\$34,800
4a. Screen	8.0	18	0.2	0.1	0.0	0.3	\$0	\$1,600	\$500	\$1,100	\$1,000	\$4,200
4b. Screen with windbreak	12.9	46	0.0	2.4	0.0	2.4	\$1,700	\$16,000	\$1,300	\$1,500	\$3,100	\$21,900
4c. Screen with windbreak and Ball Barrier	32.4	110	5.8	1.3	0.1	7.2	\$7,600	\$37,400	\$3,100	\$26,200 (b)	\$0	\$66,700
5. View enhancement (c)	8.7	100	0.0	0.9	1.2	2.1	\$1,300	\$5,500	\$2,800	\$6,100	\$300	\$14,700
6. Control tree topping	12.6	15	2.1	0.1	0.0	2.2	\$6,500 (d)	\$1,700	\$400	\$4,400	\$0	\$6,500
7. Diversity and habitat	194.9	221	5.4	6.9	1.7	14.1	\$12,000	\$75,100	\$6,200	\$5,700	\$3,700	\$90,700
8. Hazards and landscaping	590.7	120	1.2	1.5	1.0	3.7	\$3,000	\$116,600	\$3,400	\$18,200	\$0	\$138,200
Total	1,216.5	1,492	41.8	41.1	12.8	95.8	\$88,600	\$370,100	\$44,300	\$108,200	\$16,100	\$538,700

(a) Tree removals, yields, revenues, and costs are approximately twice as large in second decade as in first. Figures shown are 20-year averages.

(b) Tree planting costs in first decade approximately three times as long as in second decade. Figure shown in 20-year average.

(c) Activities completed at end of first decade.

(d) \$2,500 is from sale of forest production; remainder collected as tree-topping fees.

Partial Implementation Program

Theme and Activities. The partial implementation program is primarily limited to two major emphases. It entails care of the forest intended to achieve an acceptable risk of liability for damages due to tree failure, and it includes regenerating the Presidio's windbreak system and most other forest stands. Accordingly, this program includes the same hazard tree treatment element as the full implementation program but a broader scheduled regeneration element (applying also to lands not provided special management) (Table 8-1). This program does not include special management of historical plantings, maintenance or restoration of native vegetation, creation of new screens, enhancement of vistas, or direct development of wildlife habitat. Thus, several Forest Management Goals and Guiding Policies would not be achieved or implemented.

Because costs can be borne by benefiting, adjacent residents, the partial implementation program also includes the recommended tree-topping control program. Although no monies would be appropriated for native vegetation protection or restoration, qualified volunteer groups would be encouraged to undertake native revegetation enhancement work, subject to work plan approval.

Yield. Under the partial implementation program, an average of approximately 1,300 trees totaling 79.0 MCF would be removed annually.

Costs and Revenues. The partial program would cost an average of \$382,000 annually to implement over the 20-year planning period, as shown in comparison to the full implementation program on Table 8-3. Tree removal and reforestation would account for nearly all of these costs.

Revenues from the sale of forest products from a centralized storage yard on the Presidio would equal approximately \$79,300 per year, resulting in an annual net cost of \$320,600 for the partial implementation program (Table 8-3).

Minimum Implementation Program

Theme and Activities. This program embodies only custodial care of the forest that would achieve an acceptable risk of liability for the U. S. Army in the event of injury or property damage due to tree failure. Accordingly, this program entails only the landscape-tree hazard reduction element of the full implementation program. This program also includes a small cutting element for the edges of windbreaks and other stands, sufficient to also acceptably lessen the threat of direct property damage or injury.

As with the partial implementation program, native vegetation could be enhanced only if the necessary work were undertaken by volunteer organizations.

Yield. The minimum implementation program calls for removing an average of 271 trees per year over the next 20 years for an average annual yield of 12.2 MCF.

Costs and Revenues. As shown in Table 8-3, annual costs under the minimum implementation program would average an estimated \$174,300. All costs are for tree removal and replacement. About 80 percent of these costs would involve removing and

Table 8-3. Comparative Annual Costs of the Implementation Program Levels

Management Emphasis	Minimum			Partial			Full		
	Gross Cost	Revenue	Net Cost	Gross Cost	Revenue	Net Cost	Gross Cost	Revenue	Net Cost
1a. Windbreak	\$7,900	\$3,200	\$4,700	\$76,800	\$32,400	\$44,400	\$76,800	\$32,400	\$44,400
1b. Windbreak - landscaped	\$1,800	\$400	\$1,400	\$17,900	\$3,600	\$14,300	\$15,000	\$3,600	\$11,400
1c. Windbreak - dune stabilization	\$1,900	\$400	\$1,500	\$1,900	\$3,800	\$15,200	\$19,000	\$3,800	\$15,200
2a. Original plantings - windbreak	\$4,300	\$600	\$3,700	\$12,400	\$5,300	\$7,100	\$46,600	\$10,700	\$35,900
2b. Original plantings - entryway	\$400	\$0	\$400	\$2,600	\$600	\$2,000	\$3,600	\$600	\$3,000
3. Native vegetation	\$0	\$0	\$0	\$0	\$0	\$0	\$34,800	\$5,400	\$29,400
4a. Screen	\$1,700	\$0	\$1,700	\$3,200	\$0	\$3,200	\$4,200	\$0	\$4,200
4b. Screen with windbreak	\$5,200	\$500	\$4,700	\$18,800	\$1,700	\$17,100	\$21,900	\$1,700	\$20,200
4c. Screen with windbreak and ball barrier	\$4,000	\$800	\$3,200	\$48,200	\$7,600	\$40,600	\$66,700	\$7,600	\$59,100
5. View enhancement	\$200	\$0	\$200	\$2,100	\$300	\$1,800	\$14,700	\$1,300	\$13,400
6. Control tree topping	\$200	\$0	\$200	\$6,500	\$6,500	\$0	\$6,500	\$6,500	\$0
7. Diversity and habitat	\$8,500	\$1,900	\$6,600	\$54,200	\$14,500	\$39,700	\$90,700	\$12,000	\$78,700
8. Hazards and landscaping	\$138,200	\$3,000	\$135,200	\$138,200	\$3,000	\$135,200	\$138,200	\$3,000	\$135,200
Total	<u>\$174,300</u>	<u>\$10,800</u>	<u>\$163,500</u>	<u>\$382,800</u>	<u>\$79,300</u>	<u>\$320,600</u>	<u>\$538,700</u>	<u>\$88,600</u>	<u>\$450,100</u>

replacing high-hazard landscape trees located in proximity to pedestrian ways and structures.

Revenues would average an estimated \$10,800 per year, resulting in an annual net cost of \$163,500 (Table 8-3).

Summary of Funding Needs

Under the full implementation program, costs would average approximately \$540,000 per year over the 20-year planning period. Revenues from the sale of forest products would decrease net costs to approximately \$450,000 per year.

Under the partial implementation program, net costs would average approximately \$322,000 per year, or 72 percent of the net costs of the full implementation program.

Under the minimum implementation program, net costs would average approximately \$174,000 per year, or 36 percent of the net costs of the full implementation program.

Staff and Equipment Needs

Staff Forester

Implementation of this plan requires that a forester be hired or contracted with to supervise forest management activities on the Presidio. The forester's qualifications should include at least a bachelor's degree in forestry, plant ecology, or arboriculture, certification by the state as a registered professional forester, and substantial experience in urban forestry and personnel management. In addition, if not a certified arborist when hired, the forester should seek certification by the Western Chapter of the International Society of Arboriculture.

Responsibilities of the proposed staff forester position should include the following:

- o **Oversee tree cutting**
 - determine annual schedule of cutting program based on interpretation of this plan;
 - delineate cutting area boundaries;
 - mark trees to be harvested;
 - write standards for tree falling, removal, and site rehabilitation;
 - organize selection of contractors;

- secure any permits needed for tree falling;
 - inspect operations to ensure compliance with contract specifications and Army safety standards; and
 - issue stop-work orders as needed.
- o** **Oversee revegetation**
- determine annual schedule of revegetation based on interpretation of this plan;
 - organize selection of contractors;
 - oversee site preparation and woody debris disposal;
 - delineate planting areas;
 - obtain and ensure the viability of planting stock;
 - plan and organize erosion control efforts;
 - plan and organize native vegetation restoration projects;
 - provide technical assistance and training as needed; and
 - inspect operations.
- o** **Coordinate vegetation maintenance**
- obtain irrigation equipment;
 - oversee installation of irrigation systems;
 - schedule water applications;
 - plan and organize native vegetation maintenance projects;
 - provide training as needed; and
 - inspect operations.
- o** **Oversee forest monitoring program**
- design a permanent stand database;
 - revise the hazard tree inventory database;
 - develop data collection procedures;
 - provide training as needed;

- analyze inventory and condition data; and
- prepare periodic summary reports.

Technicians. A crew of from three to six forestry technicians should be assigned to the Presidio's forestry staff and be supervised by the forester. Candidates for the forestry technician positions should be solicited from the existing grounds maintenance crew. If an insufficient number of grounds maintenance crew members are qualified for the forestry technician position, the positions should be filled by hiring from outside the base. For example, qualified workers could be selected from the pool of seasonal workers employed by federal and state agencies such as the U. S. Forest Service, the National Park Service, and the California Department of Forestry and Fire Protection.

Qualifications for the forestry technician position should include an associate degree (or at least 2 years of post-secondary education) in technical forestry, horticulture, or arboriculture; or several years of experience in arboriculture or landscaping. The technical forestry staff should include individuals with specialized expertise and/or certification in pesticide application and tree climbing, falling, and pruning.

Responsibilities of forestry technicians should include falling and removing storm-damaged trees; pruning the lower portions of trees; planting of trees, shrubs, and grasses; chipping woody debris; grinding stumps; irrigating plantations; implementing erosion control practices; maintaining and restoring native vegetation; and conducting forest condition surveys.

Equipment

As discussed above in Chapter 7, implementing the forest management plan will require several pieces of specialized equipment, including:

- o a farm tractor or four-wheel-drive truck equipped with a winch;
- o a rubber-tired skidder;
- o a large dump truck;
- o two portable, heavy-duty wood chippers;
- o several chainsaws;
- o hand tools for tree planting, grubbing, and fire suppression; and
- o tree climbing equipment.

Depending on the scope of reforestation work conducted by private contractors and the variety of equipment these contractors own, the Presidio forestry staff's need for some of the above equipment may be so sporadic or low that its purchase may be economically unjustifiable. Heavy equipment such as the skidder can sometimes be rented or borrowed

for occasional use. For example, equipment is sometimes shared with the National Park Service (GGNRA) with payments in the form of services or materials.

Sources of Funding and Other Assistance

Funding to implement proposed forest management activities is expected to be obtained primarily from Department of Defense appropriations allocated for operating and maintaining the Presidio of San Francisco. Money may also be available from several special Defense Department accounts, from at least one state environmental fund, and from private entities interested in maintaining and enhancing the open-space benefits of the Presidio. In addition, technical assistance for further planning and implementation of the forest management activities can be obtained from various private environmental organizations and federally administered volunteer programs. These sources of assistance are described below.

U. S. Army Sources

Presidio Operations and Maintenance Account. The "Operations and Maintenance Account" is intended to fund all facilities and grounds improvements necessary to support the base's military mission. The account pays for the arboricultural activities normally undertaken by the civilian grounds maintenance staff and by private contractors.

Several changes in the organizational structure of the grounds maintenance staff designed to increase the staff's forestry and arboricultural capabilities, as described in Chapter 7, could be implemented without increasing its budget significantly. The principal additional expenses this plan recommends for the grounds maintenance staff would stem from creation of a new staff forester position and from the purchase of several new pieces of equipment. The primary forest management responsibilities of the grounds maintenance staff would include removal of down and dying trees, erosion control, pruning of hazardous limbs, and tree, shrub, and ground cover planting and maintenance.

Private contractors should be hired by the Army to undertake most of the proposed reforestation. Contract work would include all tree falling, removal, and site restoration within regeneration units, and the removal of hazardous trees requiring specialized falling techniques. Replanting of regeneration units should also be contracted. Appropriations allocated to the Operations and Maintenance Account would have to be increased significantly to fund the recommended levels of contracted forestry and arboricultural services.

Major Construction Account. The Army's "Major Construction Account" funds projects ranging in cost from \$200,000 to \$5,000,000. Major Construction Account funds may be used to pay for arboricultural services for trees adjacent to proposed construction projects. By including landscaping as a part of construction projects, the Major Construction Account could provide funding for removal and replacement of hazardous trees within Emphasis Area 8 (Hazards and Landscaping). Planned projects for which Major Construction Account funds could potentially be allocated for hazard-tree work on

the Presidio include an Army Reserve center and a new vehicle repair shop at Fort Scott. Historically, such landscaping has been a post responsibility and cost (Straub pers. comm.)

Minor Construction Account. The Army's "Minor Construction Account" funds small projects usually costing less than \$100,000. The Minor Construction Account could finance, for example, environmental mitigation measures to alleviate the adverse impacts of construction and land development projects on the Presidio. The Minor Construction Account is administered by the Forces Command, which oversees more than 30 active Army installations. Forestry and landscaping activities proposed for the Presidio would have to compete for funding with projects proposed for all other installations under Forces Command (Verkade pers. comm.).

Forest Management Fund. The "Forest Management Fund" was established to finance investments on commercial forest lands administered by the U. S. Department of the Army. The Presidio is unlikely to qualify for grants from this fund, however, for two reasons. First, this fund is constrained by law to finance forest investments only where the returns to such investments are expected to be commensurate with their costs. The Forest Management Fund cannot be used where forestry activities are expected to result in a long-term deficit, as is the case on the Presidio. Second, uncertainty over the long-term military status of the Presidio conflicts with the Fund's guidelines limiting investments to areas expected to be managed for production of forest products over the long term (Cole pers. comm.).

Non-Army Sources

Federal Agencies. Federal agencies outside the Department of Defense (DOD) are able to assist the Presidio in implementing forest management activities primarily through coordination of volunteer efforts. Investigations of potential sources of federal cooperation undertaken in the context of this planning process failed to identify any applicable federal funding sources outside of DOD.

The National Park Service and the U. S. Forest Service (USFS) both administer volunteer programs for environmental enhancement. Of these agencies, the Park Service is more likely to assume the lead responsibility for coordinating volunteer efforts on the Presidio, because of the proximity of the Golden Gate National Recreation Area (GGNRA) to the Presidio, and because the USFS's volunteer program focuses primarily on National Forest System lands. GGNRA has recently formed a habitat restoration team specifically to engage in work similar to that proposed by this plan. Volunteers working on Army property are required to sign a statement releasing the Army from claims of liability or compensation for work performed.

Unlike the USFS, the Park Service is currently permitted by internal policies to allocate staff time to volunteer projects occurring on land it does not directly administer where such projects could benefit a national park (Horner and Solas pers. comms.). The Pacific Southwest Region of the USFS is interested, however, in participating in volunteer forestry activities on the Presidio (Solas pers. comm.).

State Agencies. Several programs administered by natural resource agencies of the State of California provide grants for forestry-related projects on nonstate lands. Most of these programs, however, and particularly those programs funded by the 1988 California

Wildlife, Coastal, and Parkland Conservation Initiative (Proposition 70), are precluded from making grants to federal agencies or for projects on federal lands. For example, the state Wildlife Conservation Board, the Urban Forestry Grant Program of the California Department of Forestry and Fire Protection, the Urban Streams Restoration Program of the California Department of Water Resources, and the Local Assistance Program of the California Department of Parks and Recreation, all of which are funded primarily by Proposition 70, are restricted to making grants to local agencies and districts and nonprofit corporations (Schmidt, Geiger, Brown, and Fargo pers. comms.).

In contrast to the above programs, the Environmental License Plate Fund administered by the California Resources Agency can make grants for environmental enhancement on federal lands within the state. The Environmental License Plate Fund is focused on the restoration of natural areas and wildlife habitat, however, and is not intended for recreational or parkland enhancement projects. In addition, grants are restricted to discrete 1-year projects and are not available to assist continuing programs. Therefore, Presidio projects intended to restore discrete areas receiving little public use but providing significant wildlife benefits, such as revegetation of Lobos Creek, would be most likely to qualify for a grant from the Environmental License Plate Fund. Applications should be made through the Resources Agency. Successful proposals need to be approved by the Resources Agency, the state Legislature, and the governor (McCollum pers. comm.).

Local Agencies. The San Francisco Department of Parks and Recreation is interested in assisting with implementation of the Presidio forest management plan. Golden Gate Park, which is administered by the city's Department of Parks and Recreation, until recently faced forestry problems much like those confronting the Presidio. Much of the experience gained in reforestation of exotic forest stands at Golden Gate Park is transferable to the Presidio. For example, a tree nursery has been established at Golden Gate Park that produces seedlings that have performed much more successfully than any commercially produced planting stock used in the park. This nursery could provide seedlings for planting on the Presidio (Cooney pers. comm.).

Besides providing planting stock and technical expertise, local agencies such as the Department of Parks and Recreation could help implement the Presidio forest management plan by enabling the Army to qualify for state funding. Prohibitions on the use of Proposition 70 funds on the base could, in some instances, be avoided if the Army transferred administrative responsibility for a portion of the Presidio to a qualifying entity (e.g., the City of San Francisco) through a long-term license agreement. The Presidio golf course, for example, would be a suitable candidate for such a transfer. Through such agreements, forestry work to take place on the base could be funded through state grants made to a local agency (Geiger pers. comm.).

Private Organizations. Several environmental organizations operating within the San Francisco area are committed to the same goals sought by this forest management plan. The Nature Conservancy, for example, has an active program to restore riparian forests in California, and may be able to provide both financial and technical assistance for such work on the Presidio (Johnson pers. comm.). Other organizations that could volunteer help in implementing the forest plan include the Audubon Society, the Sierra Club, the California Native Plant Society, Friends of the Urban Forest, and Friends of Lobos Creek.

The federal government sometimes leases Army sites to private entities for construction of facilities. Lease terms could require the lessee to provide forestry or arboricultural services on leased areas.

Cost savings could also be achieved on forestry activities if the Army sold minor parcels that could logically be maintained by another entity. Candidate parcels include the islands within the Highway 101/1 interchange, which could be turned over to Caltrans or 8th Golden Gate Bridge District, and the land west of Merchant Road in the Fort Scott area, which could be sold to the bridge district or the GGNRA.

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Appendix A. List of Preparers

This forest plan was prepared by Jones & Stokes Associates of Sacramento, California, with assistance from Stephen G. Smith, forester, of Ben Lomond, California.

Principal Contributors

Kenneth Casaday is a managing environmental planner, experienced in multidisciplinary development of land and resource plans and environmental impact studies since 1970. He also specializes in preparing plans and studies involving geologic, soil, hydrologic, and geophysical factors. Mr. Casaday has managed impact assessments of several urbanization projects, a wastewater treatment plant, and a biomass powerplant in developing rural settings of northern California. He has also directed preparation of the Presidio of San Francisco forest management plan, streambank protection plans for the Sacramento and American Rivers, wetland mitigation plans for Section 404 permits, and erosion control plans.

Prior to joining Jones & Stokes Associates in 1986, Mr. Casaday worked in northeastern California as an independent land use planning consultant, a county planner, and a U. S. Forest Service resource planner and field geologist. As an independent consultant, he was wholly responsible for preparation of private development plans, county general plan elements, and EIRs for several recreational-residential projects, as well as for a hydroelectric and a biomass powerplant and a major forest highway project. Mr. Casaday was also the plan coordinator and managing editor of the Plumas National Forest plan and EIS. Mr. Casaday was a Ph.D. candidate at the University of California, Berkeley, in 1968. He received an M.A. in Geophysics in 1967, and an A.B. in Geology and Geophysics at the University of California, Berkeley, in 1965.

Nicholas Dennis is a forest economist with 15 years of experience in natural resources planning, analysis, and management. In 1981 he received a Ph.D. in forest economics from the University of California, Berkeley. Since joining Jones & Stokes Associates 2 years ago, he has managed or coordinated several projects in the areas of agricultural and natural resources management. Dr. Dennis coordinated a series of feasibility studies on alternative management strategies for hardwood rangeland for the University of California Cooperative Extension. He recently managed preparation of an urban forest master plan for a large parcel in Sacramento County, which included budgetary analyses of short-rotation hardwood production and the use of treated wastewater for irrigation. He also coordinated preparation of an EIR to restore native vegetation on Angel Island State Park. In 1983 Dr. Dennis developed a system for monitoring conversions

of timberland to nonforest uses for the California Forest and Rangeland Resource Assessment Program. Dr. Dennis received a Ph.D. in Forest Economics from the University of California, Berkeley, in 1981, and an M.S. and B.S. in Forestry from the University of Wisconsin, Madison, in 1974 and 1972.

Paul D. Cylinder is a trained botanist and plant ecologist with experience in biological resources impact assessment, mitigation planning, wetland delineation, rare plant surveying, and revegetation planning. He has prepared impact assessments and mitigation plans for riparian and salt marsh vegetation for water projects in the Salinas Valley; conducted field investigations and analyzed impacts on the vegetation of the canal systems of northern Sacramento County for proposed urban development projects; prepared impact assessments and mitigation plans for vernal pools within flood control project areas of the City of Sacramento; prepared revegetation plans for salt marshes in Monterey County; performed rare plant surveys in Sonoma, Sacramento, Placer, Monterey, and Kern Counties; performed wetland delineations in freshwater marshes, salt marshes, vernal pools, and riparian habitats in the Sacramento Valley, the northern Sierra Nevada, and coastal California.

Prior to joining Jones & Stokes Associates, Dr. Cylinder was a lecturer in plant ecology at the University of California, Berkeley. He also has wide experience as an assistant instructor in various courses covering general botany, plant taxonomy, plant ecology, ethno-botany, evolution, and general biology. He served 2 years on the Management Advisory Committee for the Berkeley reserves of the University of California Natural Reserve System. Dr. Cylinder received a Ph.D. in Botany from the University of California, Berkeley, in 1987; and a B.A. in Biological Sciences from the University of Chicago, Chicago, IL, in 1980.

Steve Chainey is a plant ecologist and revegetation expert with additional experience and education in range and wildlands science and landscape architecture. His areas of professional emphasis are natural resource planning and land management, land restoration, and revegetation. Oak restocking and riparian and freshwater wetland restoration are areas of special interest. Mr. Chainey has coordinated or managed natural resource management plans for the 13,000 acres of open space surrounding Concord Naval Weapons Station, the 2,500-acre bufferlands of the Sacramento Wastewater Treatment Plant, the University of California's Putah Creek Riparian Reserve, and the City of Winters' Putah Creek/Dry Creek open space plan. While working for the Sonoma County Regional Parks Department, Mr. Chainey designed regional park master plans. Wetland and riparian restoration projects have included Sacramento River revegetation for the U. S. Army Corps of Engineers, irrigation canal and slough revegetation for the Yolo County Flood Control and Water Conservation District, wildlife and wetland habitat enhancements in flood detention basins for private developers and for the City of Davis, and several mitigation projects for private developments in the Sacramento Valley.

Mr. Chainey's large-scale wetland research projects have included experimental vernal pool creation for Caltrans, over 250 acres of experimental watergrass wetlands under severe floodings and drawdown conditions for the Delta Wetlands Project, and over 20 miles of seeded research plots on irrigation canals in Yolo and Solano Counties. Projects under Mr. Chainey's management or participation frequently involve multidisciplinary teamwork and agency coordination with the goal of providing innovative solutions to complex multiuse resource conflicts. Mr. Chainey received an M.S. in Range and Wildlands Science in 1987, and a B.S. in Landscape Architecture in 1984, both at the University of California, Davis, CA; and an A.A. in Industrial Electricity at the Electronics Institute, Pittsburgh, PA, in 1979.

F. Jordan Lang is a natural resource scientist and vegetation ecologist with more than 15 years experience in natural resource management and environmental impact analysis. His technical training emphasis was on vegetation and wildlife habitat ecology and in vegetation management. He has been with Jones & Stokes Associates for nearly 10 years during which time he directed and supervised projects in riparian and wetland habitat restoration, water resources management, endangered species habitat mitigation, urban forest management and planning, oak woodland management, and integrated vegetation management for utility systems. Mr. Lang also has extensive experience in managing the preparation of complex EIR/EISs on major projects requiring compliance with both state and federal environmental laws. He has conducted field research and authored scientific reports on topics, such as wildlife habitat relationships in old-growth conifer forests, impacts of geothermal emissions on forest growth, and oak woodland regeneration. Mr. Lang received an M.S. in Wildland Resource Science from the University of California, Berkeley, California, in 1979, and a B.A. in Economics from Davidson College, Davidson, North Carolina, in 1967.

Stephen G. Smith is a consulting forester with extensive experience in urban forestry in California. From 1985 to 1988 he served as forester for the San Francisco Recreation and Parks Department. While in this position, Mr. Smith was directly responsible for reforestation, tree management, seedling development, forest inventory, forest restoration planning, worker safety, and public relations. He was previously employed by the California Department of Forestry (CDF), where he developed and headed a special project with the City and County of San Francisco resulting in the Forest Management Plan for Golden Gate Park and the Golden Gate Park master plan, which served as a model for parks nationwide. He subsequently established a regional field office for the California Urban Forestry Program where he was in charge of contract compliance and assistance to cities and nonprofit organizations. Mr. Smith initiated and managed the California Forest Improvement Program for the jurisdiction extending from San Francisco to Santa Barbara, acted as regional coordinator for forest practice regulation compliance, served as regional contact for the state wood energy program, and coordinated CDF actions with numerous organizations and agencies. He is a registered professional forester and a certified soil and sediment control specialist.

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Appendix B. Summary of Previous Forest Management Plan and the Hazardous Tree Inventory

Summary of "Forest Management Plan for the Presidio and East Fort Baker." J.R. McBride. 1984.

Purpose

The purpose of the plan was to provide a stand-by-stand schedule for regeneration of the Presidio's forest, based on an inference that commercial logging of the existing forest would return revenues sufficient to meet costs of regeneration. Stated objectives were to maintain the existing mosaic of forest stands serving as windbreaks; minimize hazard to human safety from aging stands in high use areas; reduce maintenance costs associated with tree fall, litter-fall, and root growth; reduce fire hazards; minimize disturbance to wildlife habitats; protect threatened and endangered species; and provide for the optimum sustained production of forest products consistent with the military mission and multiple resource use of forest stands.

Methods

Individual stands were delineated on the Presidio's standard base map (1 inch = 400 feet) using aerial photography and a field survey. An inventory was performed based on a 10 percent sample of most of the stands (although some of the stands on the golf course were apparently not sampled). The following parameters were determined for each stand: species (most stands are monotypic), acreage, number of trees, average tree height and diameter, total wood volume, average tree condition, tree regeneration, fuel condition, and understory condition.

Public meetings were conducted to elicit forest management issues and concerns from neighboring residents and various community groups. Historical issues were also evaluated. Based on this input and the inventoried condition of the forest, management prescriptions for each stand were developed. Many of the prescriptions involved regeneration cutting of the decadent stands on a priority rating basis. If fully implemented, the entire Presidio forest would have been regenerated within 20 years.

The stand-by-stand prescriptions specified the priority of treatment, the management objective, the prescription, management costs, and the volume and value of forest products that would result from the regeneration program. The management objectives included renewing windbreaks, controlling erosion, creating visual screens, restoring native flora, eliminating safety hazards, stabilizing dunes, and improving wildlife habitat. The extent of the original windbreak system was not evaluated or used in the determination of stand-by-stand objectives. Prescriptions included regeneration cuts, thinnings, coppice cuts, type conversions, and combinations thereof.

Results

This forest management plan was implemented for a short period and was then abandoned. In conformity with the plan, logging contracts were let and a few stands were cut. However, typical forest logging methods proved inappropriate in light of the prevalence of hazardous conditions in the urban setting. The Presidio staff concluded that arboricultural techniques, rather than typical silvicultural techniques, were needed at the Presidio. The need to identify individual hazardous trees in high use areas became evident. Moreover, it also became apparent that, rather than realizing net economic benefits from the sale of "forest products," regeneration of the Presidio forest would generate "woody debris," probably necessitating the expenditure of significant funds for disposal.

Uses

The forest inventory data of the 1984 plan provides a valuable basis for formulation of this plan. Moreover, the stand condition data and priority ratings can be used by a qualified professional to assist in implementation of this plan. Nonetheless, prior to each action on the ground, stand inventory information of the 1984 inventory should be field-checked for accuracy. The inventory cannot substitute for site-specific evaluation, but it can be used to arrange priorities. For this current plan, the 1984 inventory is considered generally adequate for the 20-year planning period, after which it should be repeated. The stand prescriptions of the 1984 plan, however, are superseded by the management policies of this plan, particularly the emphasis area allocations and treatments.

Summary of "The Identification of Hazardous Trees, Presidio of San Francisco." Herman Zillgens Associates. 1988.

Purpose

The purpose of this inventory was to partially replicate at the Presidio the City and County of San Francisco's Tree Hazard Survey System, one of California's most complete hazard survey systems. This project had three objectives: 1) identify trees potentially able to cause damage to persons or property, 2) set up a system to reassess trees and document their performance, and 3) develop a database to make long term forest management decisions.

Methods

The project entailed five steps. In step one, forested areas where trees can cause damage to persons or property during a storm or natural event in the next 5 years were identified. These areas were mapped and evaluated by Presidio staff.

In step two, negotiations were conducted concerning the amount of inventory and hazard data to be collected.

Step three entailed mapping and tagging each tree in the identified areas, up to a maximum of 7,000 trees.

Step four was the field survey. Inventory data were collected that identified tree species, size, general age, and whether trees should be rated for hazard (Figure 1). About 15 percent of the trees inventoried were described in detail and rated for individual hazard potential using the City and County of San Francisco's Tree Hazard Survey form.

In step five, the inventory and hazard tree records were put into a personal computer using d-base III plus language syntax and compiled using Word Tech Systems' Quicksilver d-base III plus compiler.

Results

The project product partially meets the original objectives of the Army. Due to errors and omissions, it cannot be considered complete and fully reliable at this time.

Because only 15 percent of the trees surveyed were evaluated for actual hazard to person or property, another 85 percent will eventually need to be evaluated. The determination of which inventoried trees should be evaluated for hazard is not well documented. Field review shows that the trees rated for hazard were "hazardous," but many uninventoried trees were at least as hazardous, or more so, and yet were not similarly evaluated. Each tree evaluation takes approximately 10-15 minutes, thus requiring about nine person-months to completely survey the potentially hazardous trees at the Presidio.

The mapping and tagging of the trees surveyed was done in a manner that makes it difficult to relocate trees. Locating trees actually becomes impossible if tags have been removed and/or cross referencing data are not available onsite. Additionally, many trees were numbered but not inventoried, and many trees were inventoried but not mapped.

The automation of the records is adequate. The software package is commonly used, but is limited. Data extraction, due to its compiler, is limited to 15 fields (out of a possible 85). This limitation makes the use of these data difficult for future forest management planning. A number of software defects and tree species listings errors should be corrected. However, if corrected, the automated system can be used by a novice.

The Presidio originally intended to make use of the City and County of San Francisco's mini-computer software. The organizations have identical WANG VS100 systems, which require unique software. By automating the Presidio's tree hazard data on the Wang system, nearly all 85 fields of data would be available to the forest manager, as would be tree management reports similar to those prepared by the city.

Uses

Although errors and omissions should be corrected in the near future, the inventory is currently useful for 1) placing identified hazardous trees in priority for sequential treatment, 2) documenting current tree work, and 3) making rough trend evaluations of

potential hazards based on species. Information that is currently available is used in this plan.

If the priority and documentation aspects of this product are used by the Presidio staff, the potential liability of the government due to a tree accident will be reduced because significant effort has been made to make the forest safe. This effort should be continued, leading eventually to the evaluation of the remaining trees and elimination of all significant tree hazards.

Appendix C. Some Observations of the Early Explorers

The journals of early explorers reveal much about the distribution of native vegetation. Journal excerpts, in the form provided by Clarke (1958), were used in the preparation of Figure 2-1, "Existing and Probable Prehistoric Native Vegetation." Some of the more interesting passages are recounted here.

Near Mountain Lake

In H. E. Bolton's (1930) account of Anza's California expeditions, Father Font, a priest accompanying the expedition, described the area near Mountain Lake: "This place and its vicinity has abundant pasturage, plenty of firewood, and fine water, all good advantages for establishing here the presidio. . . . It lacks only timber, for there is not a tree on all those hills, though the oaks and other trees along the road are not very far away. . . . Here and near the lake there are yerba buena and so many lilies that I had them almost inside my tent."

Anza agreed with Font's opinion of the Mountain Lake area. There was "much firewood and good pasturage, sufficient and even in superabundance for pasturing cattle. But along with these good qualities one must mention the lack of timber, for in the district examined there is none even for barracks." (Bolton 1930.)

Fort Scott Area

Font reports that the party "entered upon a mesa that was very green and flower-covered, with an abundance of wild violets. The mesa is very open, of considerable extent, and level, sloping a little toward the harbor." (Bolton 1930.)

East of the Presidio

From the hills of the Presidio, Font went down to the beach of the Marina and from there "continued along a plain in an opening made by some hills, all of very good land and well grown with grass and other herbs. In the middle of it there is a small lake like a fountain or spring of fresh water with tule. . . . It appears that this water is permanent because at the foot of the hills in their canyons it is very green and shady, with plentiful small trees. We climbed another hill and then entered a very thick grove of scrubby live oak and other small trees and brush which continues for a considerable stretch over the hills along the shore of the estuary." (Bolton 1930.)

Anza's account of the same area contains some different details. "Very soon after leaving the vicinity of our camp (Mountain Lake) I began to find running water, an infinite supply of firewood, timber for barracks, mostly of oak, both green and dry and of good thickness, but bent toward the ground because of the constant northwest winds on this coast." (Bolton 1930.)

Southeast of the Presidio

On their return journey to Monterey, the members of the Anza expedition left the camp at Mountain Lake, marched eastward, then southward, probably between Pacific Heights and Nob Hill, to the future site of Mission Dolores. Font reports that "passing through wooded hills and over flats with good land, in which we encountered two lagoons and some springs of good water, with plentiful grass, fennel, and other useful herbs, we arrived at a beautiful arroyo which, because it was Friday of Sorrows, we called the Arroyo de Dolores. On its banks we found much and very fragrant manzanita and other plants, and many wild violets." (Bolton 1930.)

Later, about 1800, George Vancouver, the noted English navigator and explorer of the west coast, found that the ride between the Presidio and Mission Delores "was rendered unpleasant by the soil being very loose and sandy, and by the road being much incommoded with low groveling bushes. . . . The barren sandy country through which we had passed, seemed to make a natural division between the lands of the mission and those of the Presidio, and extends from the shores of the port to the foot of a ridge of mountains which border the exterior coast and appear to stretch in a line parallel to it. The verdure of the plain (about the mission) continued to a considerable height up the sides of these hills; the summits of which, though still composed of rugged rocks, produced a few trees." (Vancouver 1953.)

Bayside Areas

Archibald Menzies, the official naturalist in the Vancouver party, reports that the shore around Yerba Buena Cove (east of Fort Point) was in many places covered with bushes "of a stunted scrubby appearance and not very numerous in variety. . . ." These thickets were largely composed of *Quercus agrifolia*, but *Photinia arbutifolia*, *Aesculus californica*, *Ceanothus thyrsiflorus*, *Baccharis pilularis*, *Ericameria ericoides*, *Salix lasiolepis*, *S. lasiandra*, and *Lonicera involucrata* were also present. (Menzies 1924.)

Menzies noted that the shore of the Bay just east of Fort Point and north of the Presidio was lined by a low tract of marshy ground. Firewood was difficult to acquire as there was only scrubby brush wood on the side of an adjacent hill. (Menzies 1924.)

Vancouver reports that the marshy ground was a seawater lagoon between the beach and the mainland. The brush was small bushy *Quercus agrifolia*. Fresh water was secured from a low space behind the beach, which was covered with a spiry grass and flooded with rain. When they returned the following October, this area was quite dry and the hills surrounding the Presidio appeared barren. (Vancouver 1953.)

Appendix D. Updated Forest Stand Inventory

This appendix contains an inventory of the Presidio forest stands. It gives acreage, species, stand vigor, number of trees, wood volume, and soil and geologic type for each stand shown in Figure 3-3. The allocation of each stand to a particular management emphasis area described in Chapter 5 of this plan is also given. Some stands have been divided into as many as three management emphasis areas. This division is indicated by percentages.

This inventory is based on work of McBride (1984) as updated by Jones & Stokes Associates for purposes of this report. Note that some areas of tree cover, shown in Figure 3-3, principally landscaping trees in developed areas, are not assigned stand numbers. Trees in those areas are not included in this inventory, but many have been included in the Presidio's hazard tree inventory described in Appendix B. Estimates of their numbers were made, however, and used in setting plan implementation objectives in Chapter 5.

The listing of inventory data is followed by a legend.

Table D-1. Updated Forest Stand Inventory

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
2	B	7(70), 8(20), 4b(10)	130	qsr	C	H	0.7	168	2517
3	B	7(70), 4b(30)	130	qsr	P	M	0.2	56	2598
4	B	7(80), 4b(20)	130	qsr	C	H	1.2	96	5107
5	B	7	130	qsr	A	M	0.1	520	560
6	B	7	130	qsr	M	H	0.2	56	3395
7	C	4b	230	qsr	E	H	0.5	150	5058
8	C	4b	230	qsr	E	H	1.1	330	11128
9	C	7	230	sp	E	M	0.2	24	3524
10	C	7	230	sp	E	M	0.2	24	3524
11	C	4b(50), 7(50)	230	qaf	E	M	1.2	144	13263
12	C	4a(50), 7(50)	130	qaf	E	M	0.4	48	4377
13	C	4a	130	qsr	C	M	0.2	56	3395
14	C	4a	130	qsr	E	M	0.1	12	1105
15	C	4a	130	qsr	C	M	0.2	60	2107
16	C	4a	130	qsr	A	M	0.7	847	1494
17	C	3c(r)	130	qaf	M	L	0.5	90	21189
18	C	4b	130	sp	E	M	0.3	4	262
19	C	4b	130	qaf	E	M	1.6	640	46406
20	B	4b	230	qsr	E	M	2.2	264	20086
21	C	1b(60), 7(40)	130	qd	M	L	1.2	60	10388
22	C	1b	180	qd	C	L	2.0	320	23268
23	C	1b	180	qc	P	L	1.4	84	8151
24	C	7	180	qc	M	L	0.4	64	7526
25	C	7	180	kjs	P	M	0.3	18	1079
26	C	7	180	qc	E	M	0.2	24	2210
27	C	7	180	qc	E	M	0.1	12	1105
28	C	7	180	kjs	C	L	0.2	32	6216
29	C	7	180	qc	C	H	0.2	60	1450
30	C	7	180	qc	P	L	0.1	6	212
31	C	7	180	qc	E	M	0.1	12	1105
32	C	7	180	qc	M	M	0.2	12	1633
33	C	4b	130	qaf	E	M	0.3	10	970
34	C	1b(70), 4b(30)	130	qaf	P	L	0.3	6	360
35	C	1b	130	qaf	E	M	0.1	5	735
36	CD	4b(50), 8(30), 4a(20)	130	qaf	M	L	0.6	8	1815
37	D	4b	130	qaf	C	L	0.3	40	1875
38	D	8	230	qc	C	H	0.2	9	251
39	D	8	230	qc	P	M	0.2	6	426
40	D	8	230	qaf	A	M	0.3	48	250
41	B	1a	130	qsr	C	L	0.8	45	3209
42	B	7	130	qsr	E	H	0.4	15	733

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
43	B	7	130	qsr	M	M	0.5	55	1052
44	B	1a	130	qsr	C	L	0.2	8	365
45	B	1a	130	qsr	E	M	0.1	14	912
46	B	7(80), 1a(20)	130	qd	M	L	0.6	96	16608
47	A	7	230	sp	C	L	0.4	16	730
48	B	1a	180	qd	E	M	1.8	245	16416
49	B	1a	180	qd	C	L	0.5	46	5717
50	B	1a(70), 8(30)	180	qd	C	L	1.6	184	21256
51	A	8(67)	230	qd	C	L	0.3	34	3986
52	B	1a(80), 7(20)	130	qsr	C	L	5.1	347	51214
53	B	1a(60), 3a(m)(20), 3c(m)(10)	130	qsr	E	H	5.1	1428	13994
54	B	4a	130	qsr	E	H	0.4	112	1098
55	C	4a	130	qsr	E	H	0.1	28	247
56	A	2a	130	qd	C	L	1.1	38	10465
57	C	1b	130	qd	C	L	1.2	120	1342
58	C	7(70), 1b(30)	130	qd	C	L	0.9	72	11433
59	A	2a	130	qd	C	L	3.9	1053	28143
60	A	7(60), 1a(40)	180	qd	E	M	0.6	120	2606
61	A	7	180	qc	E	M	1.1	176	16685
62	A	1a	180	qd	P	L	0.4	48	2430
63	A	1a	180	qd	E	M	1.4	382	31394
64	A	1a(90), 7(10)	180	qd	E	M	12.9	3328	231477
65	A	1a(70), 7(30)	130	qd	C	L	4.6	403	44400
66	A	7	130	qd	P	L	0.4	6	471
67	D	7	230	kjs	A	M	0.2	104	469
68	D	7	130	qsr	A	M	1.1	572	12650
69	D	2a(70), 7(30)	130	qsr	C	L	0.8	40	1938
70	D	2a(60), 7(40)	130	qsr	P	M	0.4	12	426
71	D	1b	130	qsr	C	L	1.6	80	3877
72	D	1b	130	qc	E	M	0.6	8	911
73	E	7(90), 8(10)	130	qaf	E	L	0.8	80	3085
74	E	7(80), 8(20)	130	qc	R	H	0.1	10	586
75	E	7(90), 8(10)	130	qc	R	H	0.9	89	5275
76	E	7(80), 8(20)	230	qc	P	M	0.2	60	2530
77	D	7	130	qc	E	L	3.4	391	56205
78	D	7	230	qc	M	M	0.2	18	1273
79	D	1b	230	qc	E	H	0.5	10	3630
80	D	8	230	qc	E	H	0.4	24	3265
81	D	8	230	qc	E	H	0.1	2	929
82	D	1b(80), 7(20)	230	qc	C	L	1.1	48	6631
83	E	7(70), 2a(30)	130	kjs	P	M	0.8	242	5945

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
84	E	2a	130	kjs	C	M	1.6	698	12278
85	E	2b	230	qc	E	M	0.2	30	5203
86	A	8	230	qsr	M	M	0.4	24	842
87	A	1a(90), 7(10)	130	qsr	C	L	4.4	2320	364147
88	A	7	130	qsr	P	L	1.0	45	16803
89	A	5(50), 7(50)	180	qd	E	L	0.3	13	510
90	A	1a	180	qd	C	H	0.2	242	4138
91	A	1a	180	qd	C	L	1.8	66	8321
92	A	1a(80), 7(20)	180	qd	E	M	18.3	1757	186688
93	A	1a(90), 7(10)	180	qd	E	M	4.9	637	51063
94	A	1a(60), 7(20), 8(20)	130	qd	E	M	1.8	158	14128
95	A	1a	130	qd	E	M	3.3	198	15850
96	A	8	180	qd	E	M	0.1	6	480
97	A	8	180	qd	M	H	0.3	131	1782
98	A	1a	130	qd	E	M	1.2	300	2758
99	A	1a	180	qd	C	L	0.9	198	17078
100	A	1a	130	kjs	E	M	2.9	618	57443
101	A	7	130	qsr	A	M	1.2	624	13800
102	A	7	130	qsr	P	M	1.0	463	7267
103	A	7	130	qsr	R	H	0.5	45	3623
104	A	7	130	qsr	A	M	0.4	144	294
105	A	7	130	qsr	R	L	0.3	27	2173
106	A	7	230	qsr	R	H	0.6	160	11647
107	A	7	230	qsr	A	M	0.2	104	2300
108	A	7(80), 1a(20)	130	qc	C	L	0.6	18	596
109	A	7(70), 1a(30)	130	qc	E	M	6.8	204	23838
110	E	4b(80), 8(20)	230	qc	E	M	0.9	90	3460
111	E	7(50), 8(50)	130	qc	M	H	0.2	87	3816
112	E	8(70), 2a(30)	130	qc	A	M	0.3	156	1200
113	E	2a	130	kjs	E	L	9.9	1329	147520
114	E	1b(90), 8(10)	130	kjs	E	M	0.7	364	20734
115	E	7(70), 1b(30)	230	kjs	P	M	0.4	79	2531
116	E	1b(70), 7(30)	180	kjs	E	M	0.6	24	3316
117	E	7	230	kjs	A	M	0.2	51	400
118	E	7(80), 1b(20)	230	kjs	C	H	0.4	35	480
119	A	1a(70), 7(30)	180	qd	C	M	2.1	610	75585
120	A	5(50), 7(40), 1a(10)	180	qd	P	M	2.3	1003	9828
121	A	7	180	qd	E	M	0.8	242	8441
122	A	1a	180	qaf	E	M	0.2	21	2445
123	A	1a	180	qaf	M	M	0.6	228	13843
124	A	1a(50), 8(50)	180	qd	E	M	0.4	42	4890

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
125	A	1a(70), 8(30)	180	qd	P	L	0.9	90	7592
126	A	1a	180	qd	C	L	1.6	240	27432
127	A	1a	130	qd	P	M	0.2	60	6172
128	A	1a	130	qd	P	M	0.3	81	3796
129	A	1a	130	qaf	C	H	0.1	11	679
130	A	1a(50)	130	qsr	E	H	3.9	1143	38200
131	A	2a	130	qsr	C	L	9.7	844	92262
132	A	3c(r)	130	qaf	A	M	0.3	108	1614
133	A	3c(m)	130	qaf	R	H	0.3	7	200
134	A	3c(m)(50), 7(50)	130	kjs	C	M	0.7	16	1786
135	A	5	130	qaf	P	L	2.0	309	5896
136	A	7	130	qsr	R	H	0.5	85	3587
137	A	7	130	qc	R	H	0.4	68	9350
138	A	7(90), 5(10)	130	qc	P	L	1.6	101	11725
139	A	7	130	qsr	C	H	0.4	28	1488
140	A	7	130	qsr	C	H	0.3	45	40
141	A	5	130	qsr	A	M	0.2	80	641
142	A	1a(60), 5(10), 2b(20)	130	qd	E	L	5.3	901	85966
143	E	6	180	qd	C	L	3.7	148	14727
144	A	7	230	qc	C	H	0.5	35	1345
145	A	7	230	qc	P	M	0.3	21	953
146	E	8	230	qc	C	M	0.4	89	2691
147	E	1a	230	qc	P	M	0.4	44	2119
148	E	1a(80), 8(20)	130	qaf	E	M	0.6	42	5150
149	E	1a(70), 6(30)	130	qaf	E	L	0.4	44	4281
150	E	1b(40), 6(40), 1a(20)	180	qd	C	L	8.6	430	67463
151	E	2b	180	qd	C	L	0.5	30	81
152	E	2b	180	qd	E	L	0.3	7	1900
153	E	2b	180	kjs	C	L	0.4	203	4634
154	E	2b	180	qd	A	M	0.1	100	1328
155	E	1b	130	kjs	E	M	0.2	87	9285
156	E	1b	180	kjs	C	L	1.0	165	12802
157	E	1b	180	kjs	E	M	2.1	252	10273
158	E	2b	180	kjs	P	M	0.3	8	508
159	E	1b	180	kjs	E	M	0.2	7	628
160	E	1b	180	qd	C	L	0.3	84	5923
161	E	1b	180	kjs	C	H	0.1	36	189
162	E	1b	180	kjs	E	M	0.1	12	212
163	G	3a(m)	230	qc	W	M	0.7	847	68
164	G	1c	180	qd	P	L	2.7	756	13724
165	G	1c	180	qd	C	L	0.1	32	274

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
166	G	1c	180	qd	P	L	0.5	140	1986
167	G	1c	180	qd	C	L	1.4	162	9296
168	G	1c	180	qd	C	L	1.2	384	3292
169	G	7(80), 1c(20)	180	qaf	C	L	1.1	352	3018
170	G	1c(85), 8(5), 7(10)	180	qd	M	L	16.4	5887	193018
171	G	1a	180	qd	P	L	0.3	30	2593
172	G	1a	180	qd	E	L	1.6	64	9125
173	G	1a	180	qd	P	L	0.9	90	7778
174	G	1a(50), 7(40), 8(10)	180	qd	M	M	1.7	35	3104
175	G	3b(m)	180	qd	O	M	1.1	187	815
176	G	3a(m)	180	qd	W	M	5.7	6897	552
177	G	7(80), 8(20)	180	qd	P	M	3.1	496	21492
178	F	4c	180	qd	E	H	0.2	59	1959
179	F	4c	180	qd	C	M	0.5	75	8572
180	F	4c	180	qd	E	H	1.6	469	15672
181	F	4c	180	qd	C	M	0.4	121	9510
182	F	4c	180	qd	C	M	0.7	212	16643
183	F	7	180	qd	E	H	0.2	59	1959
184	F	7(60), 4c(40)	180	qd	C	L	5.4	810	92583
185	F	4c	180	qd	P	L	0.4	25	1733
186	F	1a(80), 7(20)	180	qd	C	M	0.9	272	21398
187	F	1a	180	qd	P	M	0.2	13	866
188	F	7	130	qaf	C	M	1.1	333	26154
189	G	7(80), 4b(20)	230	qc	C	M	1.1	333	26154
190	G	7	230	qc	P	M	0.2	13	866
191	F	7	230	qsr	P	M	1.2	76	5198
192	G	7	230	qc	C	M	0.4	121	9510
193	G	7	230	qc	P	M	0.1	6	433
194	G	7(90), 8(10)	230	qc	E	H	0.5	147	4989
195	G	7	230	qc	E	H	0.3	88	2938
196	F	4c	230	qc	C	M	0.6	182	14266
197	F	4c	230	qc	C	M	0.2	60	4755
198	F	4c	230	qc	E	H	0.1	29	980
199	G	3b(r)	230	qc	C	M	0.4	121	9510
200	G	3b(r)(60), 3a(r)(40)	180	qc	C	M	0.5	151	11888
201	G	3b(r)(70), 3a(r)(30)	230	qc	E	M	5.1	1494	49954
202	G	7	230	qc	E	M	1.3	381	12734
203	F	4c	230	qc	P	M	0.3	19	1300
204	F	7(90), 4c(10)	230	kjs	E	L	5.7	1724	135523
205	F	7	230	kjs	P	L	0.1	6	433
206	F	7	230	kjs	E	M	1.7	289	27574

Stand Number	Presidio Subarea	Management Emphasis Areas (figures in parentheses are percents in each)	Soil Type	Geologic Type	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)
207	F	7	230	kjs	C	M	0.3	91	7133
208	F	4c	230	qc	C	M	0.3	91	7133
209	F	4c	230	qc	C	M	0.4	174	1711
210	F	4c	230	qc	C	M	0.3	131	1283
211	F	4c	230	kjs	C	M	0.9	272	21399
212	F	4c	230	kjs	P	M	0.1	6	433
213	F	4c	230	kjs	C	M	1.2	363	28531
214	F	7	230	qsr	P	M	0.1	6	433
215	F	7(70), 4c(30)	230	qsr	C	M	3.8	1150	90349
216	F	4c	230	qsr	C	M	0.1	30	2377
217	F	4c	230	qsr	C	M	0.4	121	317
218	F	4c	230	qsr	C	M	0.1	30	2377
219	F	4c	230	qsr	C	M	0.1	30	2377
220	F	4c	230	qsr	C	M	0.1	17	1622
221	F	4c(80), 7(20)	230	qsr	C	M	0.8	141	19020
222	A	7(80)	180	qsr	E	M	1.0	193	9795
223	F	7(60), 4c(40)	230	qsr	C	M	1.0	302	23776
224	F	4c	230	qsr	C	M	0.1	20	2378
225	F	4c	230	qsr	C	M	0.6	183	14265
226	F	2b	130	qd	C	L	0.4	33	3850
227	F	2b	130	qd	P	L	0.2	60	2223
228	G	3a(m)	230	qc	W	M	1.0	6000	48
229	G	4a	180	qaf	C	M	0.2	60	4755
230	G	4a	180	qaf	P	M	0.4	25	1733
231	G	7	180	qaf	P	M	0.3	19	1300
232	G	3a(m)	230	qc	W	M	1.1	1331	106
233	G	3a(m)	230	qc	M	M	0.1	2	131
234	G	3a(m)	230	qc	E	M	0.3	33	6929
235	G	3a(m)(50), 8(50)	180	qc	W	M	0.9	1089	87

LEGEND:**Stand Area**

See Figure 3-3.

Presidio Subarea

A = central ridgelands.
B = Fort Scott.
C = bay front uplands.
D = Main Post and Crissy Field.
E = Presidio Heights.
F = golf course.
G = Lobos Creek valley.
(See Figure 3-3.)

Management Emphasis Areas

See Table 5-1.

Soil Type

130 = typic argiustolls, loamy - urban land association.
180 = Sirdrak sand, aeolian sand on stabilized sand dunes.
230 = orthent, cut and fill.

Geologic Type

qc = Coloma formation.
qd = dune sand.
qaf = artificial fill.
qsr = slope debris and ravine fill.
kjs = sandstone and shale.
sp = serpentine.

Species

C = Monterey cypress.
P = Monterey pine.
M = mixed species.
E = eucalyptus.
A = acacia.
R = redwood.
O = oak.
W = willow.

Stand Vigor

H = high.
M = medium.
L = low.

Number of Trees

Estimated number of trees with diameter at breast height greater than 4 inches, based on sampling plots.

Tree Volume

Estimated wood volume, based on tree height and diameter plot data and assuming paraboloid shape.

Appendix E. Plan for Cultivation of Trees Upon the Presidio Reservation

PLAN FOR THE CULTIVATION OF TREES UPON THE PRESIDIO RESERVATION.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF CALIFORNIA,
Presidio of San Francisco, Cal., March 26, 1883.

*Assistant Adjutant General,
Headquarters Department of California,
Presidio of San Francisco, Cal.*

SIR:—I have the honor to submit a detailed plan for the cultivation of trees upon the Presidio Reservation.

I have given the matter considerable attention and treated it largely, because it is one of both importance and interest. The plan, although apparently so extensive, is perfectly feasible, by keeping up the accretion of small doings. Each season's work can be laid out beforehand, and the trees can be produced from seeds in unlimited numbers at very small cost. In the propagation of seeds and rearing of the young trees we cannot do better than to follow the plan in such successful operation at the Golden Gate Park of San Francisco. The trees there are raised from seed, which is planted in wooden boxes 1 ft. 6 in. x 2 ft. 6 in., and 5 inches deep. These boxes are kept, until the young trees are about 2 inches high, in glass frames, with sloping and sliding tops, each division to hold 4 boxes (about 3 ft. 2 in. x 5 ft. 2 in., inside measurement). The tops should slope towards the south, if possible. They are then removed (still in boxes) to a house 20 feet wide, with gable roof, the whole covered with laths nailed diagonally, with about half an inch between. This is to harden the young trees, which are taken from there and planted out.

There is another large glass house, 30 ft. x 100 ft.; but the chief gardener informs me the width is much too great, as the side benches are 6 feet wide and the centre one will be 12 feet, which is too great a reach for a man. He recommends that it ought to have been not over 17 feet, viz:

Bench 3 feet—passage 2 feet—bench 6 feet—passage 2 feet—bench 3 feet.

The sashes in this house are fixed, and there is a ventilator running the whole length of each wall and one along the crest of the roof. The glass, wherever used, should be coated with lime wash (with plenty of white glue) on the outside.

Plans of the seed-boxes, glass-frames, and shade-house are submitted herewith.

The earth in the boxes should be richly prepared loam. The seeds should be sown on the surface, no matter what their size, and sprinkled over loosely with sawdust, as a substitute for the leaves and leaf-mold of the forest. Germination is produced by heat and darkness. After the growth is started the plant wants plenty of light. In the planting of flowers and vegetables, gardeners have a principle of covering a seed to a depth equal to its size or thickness. This will not apply to trees. Nature plants these seeds on the surface. A tree-seed planted too deeply will come up and the young plant may seem strong and vigorous, but it will never make so strong and lusty a tree as if Nature's conditions had been more carefully followed.

Where trees are planted in sand or loose sandy soil, the ground will need no preliminary preparation; loose sand can be protected from blowing by brush anchored in by sand spaded over the butts, but ordinary ground should be coarsely broken up with the plough and not harrowed. Furrows can then be laid out as guides and aids in the planting. It is found in the Golden Gate Park that by setting out in the rainy season, the necessity of watering the young trees is entirely avoided. In transplanting, the soil about the roots should first be thoroughly saturated with water and then preserved in a compact mass or ball, for removal to the new site. This is important. Gardeners have a fancy for shaking the earth entirely free from the roots of young plants in transplanting. This is radically wrong. It saves some trouble, but seriously checks growth, and incurs unnecessary risk. A gardener meets the difficulty he has created by skillful watering. By proper care and forethought, I do not think the trees will need much attention after being once set out, a systematic annual thinning out being about all that will be found necessary.

GENERAL PLAN. (See Map.)

A large forest on each of the three principal ridges, connected by belts along the boundary fence and through the sand-drift between Presidio and Fort Point. One (No. 1) on Telegraph Hill, connecting with the two large areas of drifting sand on either side. Another (No. 2) on Presidio Hill, sweeping around from the bluff on the Fort Point road and crowning the ridge as far as the First Avenue gate. Another (No. 3) commencing at the First Avenue gate and taking in the drifting sand belt along the fence to the top of the ridge in the southwest corner of the Reservation, thence running down that ridge to where it runs out on the main road from the lower gate. Then a narrow irregular belt along the fence of the eastern boundary. Then cover the principal portion of the marsh. The main idea is, to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous, and thus appear immensely larger than it really is. By leaving the valleys uncovered or with a scattering fringe of trees along the streams, the contrast of height will be strengthened. The view from the avenue in front of the officers' quarters at the Presidio should not be restricted towards the bay by trees. Scattered clumps of trees in the valley just in front can be introduced, but not so that they will grow up and impede the main view. These groups should be composed principally of trees and shrubs showing flowing outlines, and should be artistically arranged. They occupy the frontispiece of the picture and require skillful handling.

The Presidio is the central and vital point of the composition, and I have given it an imposing background of forest overlooking great stretches of rolling greensward. This forest is, further, so disposed that there are very few points from without where its true breadth at any point can be appreciated, and it will seem to be very much larger than it is.

In order to make the contrast from the city seem as great as possible, and indirectly accentuate the idea of the power of the Government, I have surrounded all the entrances with dense masses of wood. The entrance from First Avenue leads through a long belt of wood, with vistas across the valley to the east, to the point where the road rounds the point of the hill and displays the whole of the magnificent view of the bay below. This is treated so as to burst suddenly in view, and thus heighten the effect by contrast. The Central Avenue entrance leads through a long belt of wood with vistas of the city, Alcatraz Island, etc. The Lombard-street entrance is through a narrow belt of trees. The ground here is flat and suitable for military manoeuvres, and should not be restricted by trees. The street-railroad entrance is through a mass of trees. Masses of trees should not be

introduced in close proximity to the Presidio. They would add considerably to the dampness, and thus render it less comfortable as a dwelling place. The great forest on the hill which encircles it to the windward will add very much to the comfort of this situation by modifying the force of the wind. It will probably prove an effectual wind-break for the Presidio. At the approach to the ocean on Telegraph Hill, the trees are so disposed as to develop the Pacific Ocean view suddenly, and thus heighten its effect. At (a) a beautiful mountain vista can be arranged. At (b) another mountain vista. At (c) a vista of Angel Island. But this subject can be better treated after the trees are partly grown.

This project is perfectly feasible, provided it be treated systematically and with forethought. It should be remembered that we are in the midst of a great and growing city; that the eyes of people of culture are upon us, and that it is within our power to treat this matter so as to win delight and approbation on the one hand, or contempt and derision on the other. If it be worth while to plant trees on the Reservation at all, they should be planted effectively, and not dumped into the ground by the thousand, at random. Opinions will vary as to what would be the most effective arrangements, but the variation will be within narrow limits; and there is a general coincidence of opinion concerning the leading points of good taste in such a matter. Furthermore, the question of tree planting is one of vital importance to the people of this locality, so that a well sustained and intelligent example will contribute to the material good of a great many people; and this I conceive to be a becoming thing for us to do in all cases where it is reasonably within our power. With the means at hand, and that will remain in hand from year to year, it is perfectly feasible to carry out this project. There is no hurry about it, and it can be done thoroughly and well.

In order to protect the young trees from grazing cattle, they should be fenced in. As much as can be easily planted and cared for in one season should be fenced in at a time. After the trees are once well started in growth they need no further care. Where sand wastes are treed, no cattle should be allowed to roam among the trees for a great many years, and, in fact, the whole of the tree plantations should be protected from them until they get to be of considerable size. The best and cheapest inclosure is wire fence, with lanes leading through the trees from one grazing ground to another.

Pancreast Library

Trees in masses should be planted very thickly, keeping in view the height they will attain in one year's growth, and preserving a distance between them about equal to their height. Rapid growing trees, like Eucalyptus, can be planted 6 to 8 feet apart. Those of slower growth, as near as 4 feet apart. There should be an annual thinning out, especially of the feeble, sickly, and ill-shaped plants; keeping the distance between trees about equal to their height, so that the whole ground about their roots will be reasonably shaded, as in nature. The products of this thinning can be disposed of as nursery stock, poles, firewood, timber, etc. Considerable of the work can be done by prisoners, but in any event it is perfectly certain that the operation will more than pay for itself. The principal difficulty in the way of treed this Reservation is the wind; but fortunately the whole trouble lies in one direction. During a large portion of the year, westerly winds, of exceptional force, prevail. Furthermore, they are the strongest and most persistent just at the season when deciduous trees are growing and rapidly forming tender shoots. Hence it is doubtful whether they can be successfully cultivated, except in sheltered sites and among masses of other trees. In the outset, therefore, we are almost restricted to evergreen trees that continue their growth during the winter season. Experience has proved that the regions from which to draw are the Pacific Coast, Australia, and the south of Europe. This results from a certain

similarity of geographical conditions, and these lead me to the opinion that New Zealand, the table land of Mexico, and the high lands of British India, could also be resorted to. Returning to the wind difficulty, I have met it by placing wind-breaks on the sides of masses exposed to westerly winds. These are composed of trees that have been proved able to resist the winds here, together with an outlying belt of wiry shrubbery. The trees are composed of an intermingling of needle-leaved and pendant-leaved varieties, which form a combination best adapted to resist wind. In masses, the Eucalyptus globulus is a good wind-stay, after it has attained some height, but it grows so rapidly as to be slender and weak at first. It can be introduced with much effect among masses of other trees after they have attained a few years' growth. The long slender branches whipping in the wind are very effective. And this brings me to the subject of pruning. The pruner industriously cuts these branches off, thus reducing the power of the tree to resist the wind. Doubtless, trees of defective shape can be improved by pruning, but the matter requires more than ordinary skill and judgment, and I would strongly recommend that all pruning of trees on this Reservation be forbidden. The trees that are growing here now have been most horribly mutilated. The chances are that Nature can produce stronger and better looking trees than the average gardener. Even her homeliest and most irregular productions have the merit of being picturesque.

I submit herewith a contour plan of the Presidio Reservation, showing in irregular outline the proposed tree plantations. These are subdivided into minor numbered areas—the numbers referring to the following legend, in which are given directions for the trees to be planted in each numbered area. The trees are disposed, as much as possible, so as to take advantage of their well known requirements of soil and situation. An attempt has also been made to produce massive contrasts of light and shade in the colors of the foliage.

LEGEND.

Showing the kinds of trees to be planted in the numbered areas on the map.

(1). Pines (Monterey) and Eucalypti (globulus, rostrata) and Acacia latifolia, A. lopantha, A. decurrens, A. pycnantha.
Libocedrus decurrens.

The pines should form the great mass of trees on this space, with scattered groups of the Eucalypti and Acacias. The Eucalypti should be principally disposed along the crest of the ridge, in order to increase by their great height the effect of the height of the hill.

Along the front of (1), which overlooks the Presidio, and where it borders the road, scattering Dogwoods and bright flowering Acacias should be placed, to light up the dark mass behind, as seen from the Presidio. Eucalypti should not be set out here until the others are 2 or 3 years old. Plant solid, and then thin out.

(2). Monterey cypress and Acacia latifolia, A. decurrens, A. pycnantha.
Libocedrus decurrens.

The Cypress should form the great mass of the trees on this space, with the Acacias in scattered groups among it.

(3) and (5). A mass of Leptospermum bushes, with scattered clumps of Monterey cypress, Acacia latifolia.

(4). Eucalyptus marginata, E. resinifera, Acacia dealbata, A. melanoxylon, A. pendula, A. cunninghamii, with Photinia (red berries) in a large group near the road.

(6). Same as (1), except Redwoods planted thickly along the crest of the ridge. Dogwood scattered along the road.

(7). Redwood and *Eucalyptus marginata*, and *Libocedrus decurrens*, Calif. Chestnut Oak and Tan-bark Oak.

(8). Redwoods along crown of ridge, and wherever soil is not sand, with European Oak, Calif. Chestnut Oak, Dogwood (scattered singly), and Tan-bark Oak, in scattered groups among the Redwoods. Elsewhere, masses of White Birch, *Libocedrus dec.*, *Cedrela Australis*, Riga Pine, and scattered groups of *Acacia lophantha*, *A. melanoxylon*, *A. harpophylla*, *A. pycnantha*, *A. homalophylla*.

Monterey Pine and *Syncarpa laurifolia* (resists teredo).

Eucalyptus, *E. marginata*, *E. melliodora*, *E. resinifera*, *E. viminalis*.

(9). Monterey Pine, Riga Pine, Maritime Pine. (Monterey Pine thick along fence and road.)

Bushes of *Leptospermum*, Broom, Scotch, Beach Grass, to help hold the sand until the trees get up. Masses of White Birch, Pines, and *Libocedrus dec.*, with scattered groups of *Acacia lophantha*, *A. longifolia* var, *sophorae*, *A. harpophylla*.

(9L). *Libocedrus decurrens*, Monterey Pine.

(10). Monterey Pine thick along fence. Riga Pine, White Birch, *Libocedrus d.*, in masses in the sand.

Bamboo all around the reservoir, *Acacia* around and below the reservoir dam, *Melaleuca pauciflora*, *M. squarrosa* (Australian Tea Tree).

Catalpa kienpferii, *Catalpa speciosa*.

On the hard ground small masses of *Catalpa speciosa*, Calif. Black Walnut, *Eucalyptus marginata*, *E. melliodora*, European Oak, *Cedrela Australis*.

In scattered groups, *Acacia pendula*, *A. dealbata*, *A. decurrens*, *A. cunninghamii*, Redwood, Big Trees, Tan-bark Oak, Cork Oak, Cal. Black Oak, European Oak, Cal. Chestnut Oak, Cal. Golden Leaf Chestnut, Madrona, Wild Black Cherry, *Torreya* Calif., *Thujaopsis borealis*, Calif. Great Red Alder, and the following Australian hardwood trees: *Flindersia oxleyana* (Ash), *Syncarpa laurifolia* (resists teredo).

(11). Along the fence and along the road, in a thick mass, Monterey Pine and *Libocedrus decurrens*, masses of White Birch, Riga Pine, Monterey Pine, with groups of *Acacia lophantha*, *longifolia* var, *sophora*, *harpophylla*, *Eucalyptus marginata*, *rostrata*, *globulus*, *Catalpa speciosa*, *kienpferi*. Along the front edge of the sand, in the hard ground, scattered Dogwoods, *Acacia nemu* (of Japan, red flowers), *Photinia* (red berries), California Tree Poppy.

(12). Redwoods, *Libocedrus dec.* Monterey Pine, *Eucalyptus globulus*, *rostrata*, *viminalis*. A dense mass.

(13). Redwoods and Big Trees, forming the mass with scattered groups of *Eucalyptus amygdalina*, *viminalis*, *marginata*, *melliodora*, *resinifera*, *siderophloia*.

Along the border of the fence and inside, scattered Dogwood and *Acacia dealbata*, *melanoxylon*, *cunninghamii*, *fragrans*, *nemu* (of Japan).

If buildings should be desired in this locality the trees could be reduced to a narrow belt along the fence.

(14). A wind-break, 150 feet wide, of Monterey Cypress, *Acacia latifolia*, and *Eucalyptus rostrata* along the road. Behind them, Redwoods, in mass, with scattered groups of Madrona, European Oak, *Catalpa speciosa*, *kienpferi*.

(15). An irregular belt of bushes, about 50 to 100 feet wide, to form part of the wind-break. Wind very severe along this line. Bushes as follows: Masses of *Leptospermum*, with scattered groups of *Photinia* (red berries), *Pittosporum* in variety, *Laurestinus*.

(16). Redwoods, with belt of ornamental trees along road retained as they now are.

(17). Same as (14), with wind-break along crest of ridge.

(18). Redwoods and Big Trees, as shown in special preliminary report.

(19). Along the banks of the slough, *Avicenia tomentosa* (mangrove), Bamboo, and New Zealand Flax.

In the sand, *Acacia harpophylla*, *Acacia longifolia* var. *sophorae*, *Casuarina equisetifolia*, *Casuarina quadrivalvis*, *Melaleuca pauciflora*, *Melaleuca squarrosa*, and other varieties of *Melaleuca*, *Banksia integra* (Coast Honeysuckle), *Frenela actinostrobilus*, *Frenela venucosa*. In the sand and hard soils, *Eucalyptus globulus*, *Eucalyptus rostrata*, *Batis maritima* (a shrub), Maritime Pine, Monterey Pine.

(20). Masses of Monterey Pine, White Birch; Maritime Pine, Haleppo Pine, Cluster Pine, Scotch Fir, *Eucalyptus globulus*, and *E. rostrata*.

Along the beach, *Arundo arenaria* (Beech-grass), New Zealand Flax, Lupines, *Acacia longifolia* var. *sophorae*, Yellow Scotch Broom.

(21). Same as (19).

(22). Same as (20).

(23). Shown on special sheet and legend.

(24). Leave trees as they are planted now.

(25). Shrubbery. Masses of *Leptospermum*, with scattered groups and single; *Pittosporum* in variety, especially flowering; *Ceanothus* (Calif. Lilac), *Photinia* (red berries), *Laurestinus*, *Veronica* (red and purple), *Erica* (flowering heath), *Polygala* (purple everbloom), Junipers, *Escalonia rosea*.

Bamboo on the arroyo near the causeway.

(26). Mass of *Eucalyptus marginata*, *amygdalina*, *viminalis*, *melliodora*, *resinifera*, *obliqua*.

Libocedrus decurrens, *Cedrela Australis*, Monterey Pine, with scattered Dogwood and *Acacia fragrans* on border; Bamboo along the arroyo.

(27). Calif. Myrtle, Calif. Chestnut Oak, Wild Black Cherry, Cal. Black Walnut, Cal. Black Oak, Monterey Pine, *Eucalyptus melliodora*, *E. resinifera*, *E. amygdalina*, *E. rostrata*, *E. Marginata*.

(28). This is mostly drifting sand, very much exposed to the wind. Where barren, plant first with Beach-grass and seeds of Lupine. Also soaked Oats over the whole area. Then plant masses of *Leptospermum levigatum* (sand-stay bush), mixed with Maritime Pine, Monterey Pine, Monterey Cypress, *Acacia longifolia* var. *sophorae* (this will grow right down to the beach), New Zealand Flax (near beach), *Acacia harpophylla*, *Acacia latifolia*, Riga Pine, Common Broom. Afterwards remove the bushes and replace with Pines, Monterey Cypress, and *Acacias*. Protect moving sand by brush, anchored down with sand shoveled over the butts.

(29). Masses of Monterey Pine, Riga Pine, Haleppo Pine, Cluster Pine, *Libocedrus decurrens*, Scotch Fir, with scattered groups of *Acacia longifolia* var. *sophorae*, *Acacia harpophylla*, *Acacia latifolia*. Where difficulty arises in the sand, first plant Lupines, Beach-grass, *Leptospermum levigatum*.

(30). On border towards the sea, a wind-break, 150 to 200 feet wide, of Monterey Cypress, Monterey Pines (these do not do well indiscriminately mingled together—plant them in separate masses or groups), *Acacia latifolia*, *Acacia pycnantha*. After these are two or three years' growth, plant thickly among them *Eucalyptus globulus*.

Behind this, masses of *Libocedrus decurrens*, Calif. Chestnut Oak, Cal. Wild Black Cherry, Cal. Black Walnut, White Birch, with scattered groups of *Madrona*, Calif. Myrtle, *Pittosporum*, *Acacia decurrens*, *A. dealbata*, *A. Melanoxylon*, *A. cunninghamii*, *A. pendula*.

(31). Same as wind-break in (30).

(32). Masses of White Birch, *Libocedrus decurrens*, Haleppo Pine, Riga Pine, Monterey Pine, Scotch Fir, with scattered groups of *Acacia pycnantha*, *A. lapantha*, *A. harpophylla*.

Where sand drifts, treat it first as in (28).

(33). A mass of shrubbery to break up the wind. *Leptospermum levigatum* in large masses, with groups of Maritime Pine, *Acacia lopantha*, *A. harpophylla*, *A. longifolia*, *Pittosporum* in variety, *Photinia* (red berries), *Laurestinus*, *Veronica* (red and purple), Yellow Scotch Broom, Spanish Broom, *Malva*, with scattered Dogwood (Cal.), *Banksia integra* (Coast Honeysuckle).

(34). *Libocedrus decurrens*, Monterey Pine, *Eucalyptus globulus*.

The borders of tree masses should be irregularly undulating, and where exposed to view from thoroughfares, ornamental trees and shrubs, especially of the flowering sort, should be scattered about with apparent carelessness. Trees for this purpose: Norfolk Island Pine, Australian Palm (*dracena*), *Grevillia robusta*, *Magnolia grandiflora*, *Pinus sabiniana*, *Acacia nenu* (of Japan), Great Flowering Dogwood (of California), *Acacia fragrans*, Lawson's Cypress, *Torreya Californica*, *Melaleuca* in variety, Oleander, red, Pepper Tree, Flowering Almond, *Pittosporum* in variety.

The following bushes and vines: Cherokee Rose, *Ceanothus* (Calif. Lilac), *Photinia* (red berries), *Pittospermum* (flowering), *Yucca*, *Laurestinus*, *Veronica*, Purple everbloom bush (*Polygala*), *Erica* (heath), Junipers.

The guiding lines in the areas laid out for tree plantations are the crest of the ridges, the roads, and the boundary fences.

SPECIAL LEGEND FOR SPACE FRONTING PRESIDIO.

Trees.

- Cal. Laurel.
- b. Bamboo.
- L. *Eucalyptus marginata*, *resinifera*, *melliodora*, *vininialis*, *siberiana*.
- m. Cal. Myrtle.
- o. Chestnut Oak.
- a. *Acacia decurrens*, *dealbata*, *melanoxylon*, *pendula*, *cunninghamii*.
- u. *Acacia pycnantha*, *latifolia*, *fragrans*.
- z. Groups. Madrona, Cal. Chestnut Oak, Myrtle.
- u_{ii}. *Acacia nenu* (flowering Japan).
- u_{iii}. *Acacia latifolia*, *Pittosporum*.
- u₄. *Acacia fragrans*, *Pittosporum*.
- p. *Pinus insignis*, Monterey Pine.
- w. Monterey Cypress, Wind-break, *Acacia latifolia*.
- 1. Flowering Almond.
- n. *Araucaria*, Norfolk Island Pine.
- 2. *Grevillia robusta*.
- L. *Pittosporum*.
- l. Lawson's Cypress.
- d. Palm, *Dracena Australia*.
- p. Pepper Trees.
- c. *Casuarina*.
- c. *Cedrela Australia*.
- t. *Torreya*.
- s. *P. Sabiniana*.
- e. *Eucalyptus marginata*, *maculata*, *vininialis*, *resinifera*, *amygdalina*, *obliqua*, *rostrata*.
- d. Dogwood (flowering).

Bushes.

- Broom, Scotch, Spanish.
- 2. Red berries (*Photinia*).
- 3. Groups. Cal. Lilac, *Leptospermum*, *Acacia fragrans*, Roses.
- 4. *Leptospermum*.
- 5. Broom, Scotch.
- 6. *Ceanothus*, Cal. Lilac.
- 7. Purple everbloomer (*Polygala*).
- 8. *Veronica*.
- 10. *Laurestinus*.
- 11. Agave.
- 2. Red berries, Cherokee Rose.

Through the courtesy of Professor E. W. Hilgard, of the University of California, I have obtained an analysis of the Presidio soils, and valuable suggestions as to their treatment. That concerning subsoil plowing deserves especial attention, wherever the hard subsoil comes near the surface. I append his valuable letter in full.

Very respectfully, your obedient servant,

W. A. JONES,

Major of Engineers.

UNIVERSITY OF CALIFORNIA,
COLLEGE OF AGRICULTURE,

Berkeley, April 5, 1883.

*Major W. A. Jones, U. S. Engineers,
Presidio of San Francisco.*

DEAR SIR:—I transmit herewith the results of the analyses of two of the soils from the Presidio Reservation, sent by you, in accordance with your letter of January 24th. The work has been delayed in consequence of unexpected business connected with the session of the Legislature.

On examination, I find that the two sandstone soils, Nos. 1 and 3, differ only in the proportion of vegetable matter; and, furthermore, that the serpentine soil and subsoil are also mainly derived from the same materials as the others, the serpentine contributing only a little of its powder to the mass, but nothing that would make the two soils differ in any essential respect, save that on the whole the serpentine soil must be considered somewhat poorer in the ingredients of plant-food.

The analyses show a full supply of potash and lime, the latter being less in the subsoil, however. On the other hand, phosphoric acid is quite deficient, both in the soil and subsoil, for instead of a minimum of at least between .050 to .060. This implies that the soil will do fairly for coniferous trees, but for such as usually grow in lowlands or other rich soils, would need help in the way of manure—say especially bone-meal. With the aid of that and water you can make anything grow on the soil, for it is otherwise of good composition, and of good physical properties. In working it, it is desirable not to turn up the subsoil,—e. g.: If plowed, let a turning plow go ahead, running say 6 or 8 inches deep, according to the depth of the dark-colored surface soil, and then let a regular "subsoil plow," which only stirs the subsoil without turning it up, follow in the same furrow. This will tend to preserve moisture during the dry summer, and give the roots a chance to go deep for it.

The soil is surprisingly different from that of the Golden Gate Park, being disposed to be heavy instead of excessively sandy; so the experience had there, so far as the soil is concerned, will not apply directly to the Presidio.

Very respectfully and truly,

(Signed) E. W. HILGARD,
Prof. Agr.

ANALYSES OF PRESIDIO SOILS.

	Sandstone soil.	Sandstone subsoil.
Insoluble residue.....	78.135	70.224
Soluble silica.....	3.458	5.532
Potash.....	.675	.590
Soda.....	.080	.172
Lime.....	.846	.390
Magnesia.....	.780	1.221
Br. ox. manganese.....	.053	.059
Ferrie oxid.....	5.682	7.268
Alumina.....	5.162	9.737
Phosphoric acid.....	.031	.011
Sulphuric acid.....	.053	.022
Organic matter and water.....	5.404	4.900
	100.359	100.135
Humus.....	2.284	
Available inorganic.....	1.045	
Hygroscopic moisture.....	6.023	9.411

Appendix F. Important Forest Insects at the Presidio

***Dendroctonus valens* (Red Turpentine Beetle)**

This insect attacks the base of injured, dying or healthy trees, or freshly cut logs and stumps of all pines and occasionally spruce, larch, and fir. Ordinarily, it is not considered an aggressive tree killer, but it does do considerable primary damage and so weakens trees as to make them more susceptible to attack by other bark beetles. However, it sometimes causes sufficient damage to kill Monterey pines.

The adults are the largest bark beetles of this genus, measuring from 0.25 to 0.375 inch in length. They are distinctly reddish in color. Their attacks are characterized by large, reddish pitch tubes. On burrowing under the bark, the beetles excavate irregular longitudinal egg galleries between the bark and the wood. These galleries range from a few inches to several feet in length. The galleries are more or less packed with frass, and eggs are laid in groups or masses at intervals along the sides. The larvae feed out through the inner bark in mass formation, producing a cavity ranging from a few square inches to a square foot or more between the bark and wood. These chambers are often filled with a resinous liquid that apparently has no injurious effect on the developing broods. Transformation to the adult stage occurs within pupal cells constructed in the boring dust of the brood chamber or in short mines along its margin.

This beetle is seldom of serious importance. Should control measures become necessary, the broods can be destroyed by removing the bark from the infested areas of stumps and trees. For the protection of individual park or shade trees, the damage can be halted by cutting out the attacking beetles with a knife or chisel as soon as the pitch exudations indicate their presence. Successful control also has been obtained by injecting carbon disulfide into the galleries. *D. valens* has been found on both Monterey and Cluster pines in San Francisco.

***Phoracantha semipunctata* (Longhorn Eucalyptus borer)**

The eucalyptus longhorn borer is a serious pest of eucalyptus trees. Originally found only in Australia, it has spread to New Zealand, Asia, Africa, Europe, South America and recently to the United States. Following its discovery in southern California in 1984 the beetle has now spread from Orange County to Los Angeles, San Bernardino, Ventura, Riverside, San Diego Counties. In 1989 sightings of the beetle were confirmed in Contra Costa and Alameda Counties. The northern California populations are believed to have developed from beetles imported to northern California independently of the older southern California populations. Importation of eucalyptus lumber products and transportation of eucalyptus firewood are the primary mechanisms of long-distance beetle movements.

The adult is a blackish-brown beetle approximately one inch long. Each wing cover is rough and bears a zigzag-shaped cream-colored marking in the front and is smooth with a single, similar colored spot at the rear. The antennae of male beetles are noticeably longer than the body; those of the female are about the same length as the body. These give the beetle the name "longhorn."

Larvae are roundheaded borers that grow to 1.5 inches long. They feed in and under the bark of eucalyptus, producing tunnels which may be over an inch in width and several feet in length. These tunnels are densely packed with a very fine granulated sawdust which is often visible in cracks in the bark. Adults begin to emerge in April and are active throughout the spring and summer months. Females lay 200-300 eggs under loose bark in clusters of 20 - 30 which hatch in two weeks.

The insects prefer to lay their eggs in trees stressed to drought or soil nutrient deficiency, or in recently cut or fallen eucalyptus logs and branches. Healthy trees usually produce enough sap (called gum) to drown newly-hatched larvae. Once cut, no species of eucalyptus is immune to attack. Egg laying occurs quickly, generally within two days of cutting and a generation of beetles can be produced within three months.

Control methods include;

- o burying or chipping infested wood or covering it with tarps for at least six weeks;
- o pruning trees and cutting wood during the winter and early spring when adult beetles are inactive;
- o quarantining eucalyptus firewood and chips produced in infested areas; and
- o periodic watering during droughts.

***Phloeosinus cupressi* and *P. cristatus* (Cypress Bark Beetle)**

This insect and *P. cristatus* are at times very destructive to Monterey and other cypresses in California. Besides killing many trees outright, they mine and kill the twigs of ornamentals, making them unsightly. They often work in conjunction with cypress canker to cause tree mortality. Keeping trees healthy is the best protection against cypress bark beetle attacks; direct control is practical only for isolated infestations.

Appendix G. Important Forest Diseases at the Presidio

This appendix was adapted from the Golden Gate Park Forest Management Plan (California Department of Forestry 1980).

Trunk and Root Diseases

***Armillaria mellea* (Armillaria Root Disease)**

Hosts: A wide variety of plants are attacked by this fungus including most trees and shrubs as well as herbaceous plants and vegetables. In San Francisco, it is found on Monterey pine, Cluster pine (*P. pinaster*), Monterey cypress, California live oak, eucalyptus, *Paulownia fargesii*, satsuma plum, and azalea. Symptoms resembling those of *A. mellea* have been found on other trees and shrubs, but these have not been positively identified.

Range: This fungus is widespread, and is common throughout most forested areas. It is present in both the temperate and tropical regions and occurs throughout California.

Symptoms: Decline in vigor of the host as a whole or certain branches is usually the first external indications of the disease. Leaves may turn yellow and drop prematurely. Branches may die back. Some plants, like Douglas-fir, often produce a heavy crop of small fruit known as a survival crop, the year previous to dying. Pines usually have an abnormal resin flow from the root collar, sometimes so great that the litter and soil are compacted into a hard crust. Other plants may exude gums or sticky juices.

Removal of the bark near the crown of the affected plant usually exposes whitish-yellow mycelium plaques, made up of one to many fan-like mycelial felts from .5 to 1.5 inches in diameter (size of felt depends somewhat on size of host). Flattened string-like brown to black rhizomorphs or "shoestrings" often form under the bark on the roots and root collar and out into the soil adjacent to severely infected roots. The rhizomorphs can be mistaken for tree rootlets, but they branch differently and are filled with whitish mycelial strands instead of wood fibers.

The fruiting bodies, yellow capped mushrooms covered with dark brown scales, when present, offer positive identification. The yellow or honey colored cap is 2-5 inches across, and the yellow to brown stalk, which usually has a ring just below the gills, is about 3 inches or more in length. The mushrooms grow on the lower trunk of dead or dying trees, on stumps, or on the ground near infected roots. They are short-lived, annual fruiting-bodies that may occur singly, but they more commonly occur in groups of several to a 100 or more. The mature mushrooms release many tiny spores, produced on their gills, that are windborne to other infection sites such as stumps or woody debris. Infection of living trees by spores has not been demonstrated.

A. mellea is most commonly spread to living trees by the rhizomorphs or by root contact. In younger trees, the pathogen advances rapidly through the inner bark to the root collar, where it girdles and kills the tree. In older trees, this advance through the inner bark proceeds much slower. Like most diseases, *A. mellea* favors a weakened host. Drought favors the disease. Moving plants outside their natural range increases their probability of attack. Injuring roots while transplanting makes them more susceptible to infection.

A. mellea is a facultative parasite, that is, it is normally saprophytic but capable of changing to a parasitic life. This is particularly true when the fungus emerges from oak stumps and roots.

Control: Like many similar diseases, direct control is rarely possible. *A. mellea* is sensitive to drying and grows most rapidly under wet conditions. Heavy watering should be avoided.

Preventative measures that maintain conditions favorable for rapid and vigorous tree growth will usually keep damage by this disease to a minimum and are generally more practical. Even when trees begin to show signs of infection, proper fertilization will usually prolong the life of the tree for many years. When the base of a tree or roots have been wounded, the exposed wood should be treated with a disinfectant such as bordeaux paste.

Chemicals have been used most effectively to treat contaminated soil that is to be planted. Certain fumigants have been particularly effective; for example, carbon disulfide has been used for many years in California to control *A. mellea* in citrus orchards.

Another precaution is to remove old stumps and as many of their roots as possible. Also, when a tree falls, breaks, or is cut, the stump with its roots should be removed. These recommendations are made because *A. mellea* can buildup rapidly in the dead wood of the stumps and roots. The fungus appears to become especially virulent when it is cultured in oak stumps and roots.

***Fomes applanatus* (Shelf fungus)**

Hosts: The fungus is usually found on old logs, stumps, and the exposed wood of living broadleaf trees. It is occasionally found on conifers. In San Francisco, it is found frequently on coast live oak, acacia, and eucalyptus.

Range: *G. applanatum* is found throughout North America. In Golden Gate Park it is the most frequently observed fungus.

Symptoms: The fruiting bodies are usually found near the ground, though occasionally they arise above 25 feet. Corky when fresh, rigid when dry, the fan-shaped bracket is brown and woody on the upper surface, and white on the lower pore surface, which turns brown when bruised. They vary in size from 3 to 36 inches across. More than one fruiting body is often found on a single stump.

Fruiting bodies are produced abundantly on dead wood and less frequently on living trees, where they always develop from wounds. In older trees, it rots the roots and heartwood and can cause premature falling of the trees. The decay caused by this fungus appears white to straw colored, mottled and stringy, soft and spongy.

Control: No control is known for *G. applanatum*, but any procedures to minimize the wounding of trees is beneficial. When pruning the branches of hardwoods, the application of a disinfectant to the exposed surface is recommended. It might be advisable to remove trees supporting sporophores as they already have a varying degree of heart rot. In addition, the removal of the infected trees would greatly reduce the source of infecting spores.

***Coryneum cardinale* (Cypress canker)**

Hosts: Both wounded and unwounded tissues are sites for infection.

Range: This disease is absent from the natural range of Monterey cypress (the Monterey Peninsula). It is, however, a problem on Monterey cypress (and has been found on Coast redwood) outside of its natural range. One tree in Golden Gate Park was found to be infected with this fungus.

Symptoms: Fading and death of twigs, branches, and tops of trees are the most conspicuous symptoms of infection. Resin flow usually accompanies canker development, and as the killed bark tissues dry out a sunken area develops. The presence of cankers is a sure indication of infection. Cypress bark beetles are often associated with, and hasten the death of, infected trees.

Dark, irregularly shaped, blister-like fruiting bodies 0.3 to 1.5 mm in size are produced and break through the bark of the dead tissues. Cankers grow more rapidly along a branch or trunk than around it, and they usually have a length-width ratio of about 3:1. Infected trees or branches 2-3 years old may be killed within a year. Larger branches or trunks of infected trees may remain alive for 5-10 years.

Control: Cankers should be cut out and destroyed, followed immediately by spraying of the surrounding host trees with a fungicide; particular care should be given to covering the twigs, branches, and trunks.

***Fusarium subglutinans* (Pine pitch canker)**

Hosts: Pitch canker is a damaging fungus disease of pine trees. It is especially damaging to Monterey pine. Other susceptible pines include bishop, scotch, ponderosa, digger, coulter, Italian stone, aleppo, sugar, knobcone, eldarica, and jeffrey.

Range: This fungal disease, which was first reported in California in 1986, has been found in portions of Alameda, Monterey, Santa Clara, Santa Cruz, San Mateo and San Francisco Counties. It also occurs in the southeastern states from Virginia to Florida and west to Texas. Pine pitch canker primarily affects highway, park, and residential plantings. The disease has not been found in natural Monterey pine stands.

Symptoms: The first visible symptom of the disease is a color change in the tree. Foliage on the infected canopy branch tips fades from the normal dark green to lime green to yellow and red before needle drop. This change may occur within one growing season or may extend into the next year.

Branch cankers often exude pitch that falls and forms a whitish crust on the green needles below. The infected wood under the bark is resin-soaked and amber in color.

Cankers may form on the main stem of a tree. Like branch cankers, stem cankers cause large amounts of pitch to flow freely down the tree trunk. These stem infections are often hidden by branches and thus hard to see.

Pine pitch canker can occur on tree roots in lawns and heavily trafficked areas. Roots damaged by lawn mowers or cars are readily infected by the fungus.

The disease appears to be more severe where Monterey pine is densely planted. However, canker infections can be found on less crowded and even on isolated trees. Tip, branch, and stem infections probably occur through wounds created by insects and storm damage. Severely infected trees may eventually be killed by insects such as bark beetles and borers.

Control: To help reduce the spread of pine pitch canker, plant pathologists currently recommend the following treatments:

1. Prune infected branch tips or entire branches. After each cut, disinfect cutting tools with aerosol spray disinfectant or 70 percent alcohol solution.
2. Do not prune diseased trees during windy or rainy periods.
3. Cut down all trees with cankers on the trunk.
4. Do not move diseased wood outside the infected area.
5. Do not replant with any species of pine.

Peridermium harknessii (Western gall rust)

Hosts: This fungus has only two known stages, pycnial and aecial. It occurs on most of the 2- and 3-needled hard pines throughout their range in the western United States. It has been found on 22 species of pine in the west, but only on Monterey pine in San Francisco. Neither telial nor uredial stages of the rust are known.

Range: *P. harknessii* is common in western North America from Mexico to Alaska, and eastward to Nebraska. It has been reported on Jack pine as far east as Quebec. It is widespread throughout California, and is especially prominent on Monterey pine in both its natural range and throughout the state, wherever it has been planted. It is just as prevalent on lodgepole pine throughout the Sierra Nevada and southern Cascade Ranges.

Symptoms: The rust first appears as a small swelling in the bark of a limb or stem. This usually become visible about 1 year after infection occurs. The swelling causes the cells to divide rapidly, resulting in a woody gall, which, at first, is rather soft. These later harden and become more decay-resistant than normal wood. The penetration of the mycelium into the cambium spreads around the limb or bole about as fast as it elongates, giving the infected area a globose or ball-shaped form. Aecial pustules, bearing the aeciospores, are produced in the spring and early summer of the second or third year after infection, and usually every year thereafter so long as the rust lives, which may be one more year or for a century or two. Aecia develop under bark scales, on old cankers, and appear at maturity as little white mounds of irregular shape on galls or at the edge of cankers. The aecial pustules rarely emerge when the bark becomes thickened.

P. harknessii is an obligate parasite (lives on only living host cells), its pycnial and aecial stages occurring on 2- and 3-needled pines. Apparently, infection occurs throughout the summer on the younger bark (generally on the current season's bark) directly from aeciospores. No alternate host (telial and uredial stages) has yet been found.

Usually galls live only a few years, because when aecia are produced the host bark is disrupted to the point that it dies, thus killing the twig, limb or stem on which it grows. Trunk galls on young trees usually prove fatal. Limb galls, unless adjacent to the bole, do little damage as they kill only the one limb or the portion distal to the gall. Heavy damage may occur in young stands and plantations, but this is rare. When it does occur it is confined to small areas (a few acres at most).

New cankers frequently cause the infected wood to become impregnated with resin and actually strengthen the wood; however, the fungus kills the wood and prevents further growth in the vicinity of the canker. The wood above and below the canker grows normally, but often the wood on each side of and opposite the canker grows more rapidly, forming callous tissue. This in turn often causes a broadening of the canker and in many cases results in a slight bend or crook in the bole at the point of the canker. After many years, the lack of growth on the face of the canker leaves a depression in the bole that causes it to weaken.

Control: Gall rust can be fairly well controlled by removing the cankers as they appear. To remove a limb-canker, the limb should be severed about six inches from the canker on the proximal side. Bole cankers in young trees can be cut about 6 inches below the canker. A limb will turn up in a year or two and form a new leader.

Polyporus schweinitzii (Velvet top fungus)

This disease is also known as "red-brown butt rot." It causes a cubical rot of the heartwood of both roots and butt of living trees and may continue development in dead trees, logs, and stumps.

Hosts: It is usually found on conifers but occasionally on hardwoods. It has been recorded on *Abies*, *Larix*, *Pinus*, *Pseudotsuga*, *Thuja*, *Tsuga*, and *Taxus* as well as on *Betula*, *Halesis*, *Prunus*, *Quercus*, and *Eucalyptus*. *P. schweinitzii* was found on Monterey pine at two locations in Golden Gate Park.

Range: The fungus is widespread throughout Europe, Asia, and North America. it is most prevalent along the Pacific Coast.

Symptoms: The annual fruiting bodies, which develop most abundantly during moist weather in the late summer and fall, are to be found on the butts of infected trees issuing from old wounds or on the ground nearby, coming up from a decayed root. On the tree the sporophore is a thin bracket, and frequently two or more brackets grow one above the other. When the sporophore is on the ground, and viewed from above, it is circular in shape and sunken in the center, tapering to a short thick stalk. When fresh, the upper surface is velvety, concentrically zoned, and reddish-brown in color with a light yellow-brown margin. The undersurface is dirty green and turns red-brown when bruised. When old and dry, they become corky and have a deep red-brown or blackish-brown color. Infection occurs largely through basal wounds, particularly fire scars and vandalism.

In the advanced stage of rot, the wood is yellow-brown to red-brown in color (depending on the host), brittle, and breaks into large cubes that can be easily crumbled into a fine powder on drying. Thin crust-like layers of mycelium that are easily mistaken for resinous crusts are formed in the shrinkage cracks.

Control: No control for *P. schweinitzii* is known. When an infected tree is found, the entire tree including its stump should be removed. This eliminates a new source of infecting spores.

***Agrobacterium* spp. (Crown gall)**

Hosts: This bacterium is quite commonly found on ornamentals of the genus *Prunus* and especially on plants of the rose family.

Range: The disease is worldwide in distribution. It has been found in Golden Gate Park, occurring on a variety of species of oak, eucalyptus, and myoporum.

Symptoms: This disease is caused by a bacterium. Galls varying from the size of a walnut to a football develop on roots, and occasionally on stems of ornamentals, as well as on trunks of some trees.

A. tumefaciens is not usually considered as a problem or threat to trees, but can be harmful to ornamentals. Injuries to shrubs or trees, such as wounds caused by lawn mowers or vandals, can increase the likelihood of a crown gall formation.

Control: The disease is controlled by avoiding injury to roots, preventing waterlogging of the soil, destroying severely diseased plants, and pruning off aerial galls which are loosely attached to stems (i.e. not surrounding the stem). Before planting in infected soil, roots of ornamentals can be dipped in copper fungicide. Antibiotics, such as bacitin or streptomycin, are useful for reducing infection. A bacterium is now being used to compete for food, with *A. tumefaciens* as a control measure.

Heart Rots of Trunk and Limb

Fomes pini (White pocket rot)

This is a heartwood rot known as red ring rot, white pocket rot, pecky rot, honeycomb rot, red heart, or white speck.

Hosts: In San Francisco, this fungus is found on Monterey pine. Douglas-fir, spruce, larch, true firs, pines, and most other coniferous species are also susceptible. It is also known to occur on birch, hawthorn, and maple.

Range: The fungus is found worldwide. In the western United States it is considered to be the most damaging heart rot organism.

Symptoms: This disease often occurs singularly on isolated trees. The best indicator of the disease is its perennial woody fruiting body. These fruiting bodies do, however, vary in shape, size, and texture. They appear thin, shell-shaped to hoof-shaped, ranging from 1 to 12 inches long, .5 to 4 inches wide, and .25 to 5 inches tall. The upper surface is usually furrowed concentrically and dark brown to blackish in color. The lower pore surface is rusty-brown with circular to maze-like pores. A velvety margin often separates the two surfaces. Several fruiting bodies may be present on a single tree, most commonly arising from knots or branch stubs. Open wounds are rarely affected. By the time the sporophore appears, the heart rot has advanced about 10 feet both up and down the bole.

The decay causes a discoloration of the heartwood. In pines, a reddish or pink color is present. The advanced stages generally appear as a few to many elongated spindle-shaped, pointed pockets or cavities aligned parallel to the grain and separated by apparently sound wood. The wood often becomes infiltrated with resin. The decay is confined to the heartwood but it may attack living sapwood after the heartwood rot is well advanced.

Control: In parkland situations, the removal of affected trees is advised. This will curtail the number of spores present for further infection.

Polyporus basilaris (Cypress heart rot)

Hosts: Monterey cypress (*cupressus macrocarpa*).

Range: The disease occurs in natural stands in California, and nearly every area where Monterey cypress has been planted along the Pacific Coast.

Symptoms: *P. basilaris* causes a brown cubical pocket rot in the butts and lower bole of Monterey cypress. The pockets are sharply delineated from adjacent firm wood. In the advanced stages of decay, the pockets coalesce to form masses of rot with thin strips of firm wood scattered through the mass. The small (1-2 inches across) conks are variable in shape, imbricated (overlapping), and bracket-like where well developed. The conks are tough, leathery, and dirty grayish to blackish when dry. One to several fruiting structures may be present, and these usually arise from branch stubs. The entrance of the fungus is

thought to be through dead branches. In general, cypress trees 60-70 years and older are severely infested, but trees less than 26 years old are practically rot-free.

Control: No direct control is known at present to reduce the spread of the fungus. Dead branches should be pruned and large, older, and weakened trees should be removed. It is always good practice to prune lower limbs on the trees while they are small, which allows the knot to heal over quickly. This helps to prevent *P. basilaris* attacks and alleviates the problem of pruning larger, heavier branches in the future.

Polyporus sulphureus (Sulfur fungus)

This fungus causes a brown cubical rot of the heartwood of living hardwoods and conifers, occasionally killing living sapwood.

Hosts: *Abies*, *Acer*, *Castanea*, *Eucalyptus*, *Fraxinus*, *Gleditsia*, *Juglans*, *Larix*, *Liriodendron*, *Picea*, *Pinus*, *Prunus*, *Pseudotsuga*, *Quercus*, *Robinia*, *Schinus*, *Tamarix*, *Tsuga*, *Ulmus*, *Celtis*, and *Fagus*.

Range: The fungus is common throughout southern Alaska, southern Canada, and the United States. It was found in Golden Gate Park on a fallen eucalyptus tree and on an open wound of a living Monterey pine.

Symptoms: The sporophores, when fresh, are soft, fleshy and moist, with a bright orange-red upper surface, brighter at the margin, and a brilliant sulfur-yellow underneath. When old, they are hard, brittle, and chalky or dirty white in color. The annual shelf-like sporophores, containing pores in its under surface, are conspicuous and frequently overlap one another in clusters of from 2 to 20 or more. Infection occurs through dead branch stubs and wounds. This fungus produces conidia as well as basidiospores.

Control: There is no known control for this fungus. It is recommended that infected trees be removed to reduce the source of infecting spores.

Fomes igniarius (False tinder fungus)

This is a white trunk rot and is destructive of many of its hardwood hosts. This decayed area is bounded on the outside by conspicuous dark zones or black lines. A single conk of average size indicates a rot column of 15 linear feet or more in the heartwood.

Hosts: Hornbeam, hop-hornbeam, birch, chinquapin, dogwood, cascara, manzanita, maple, madrone, *Adenostoma*, pear, beech, ash, walnut, poplar, oak, willow, and elm. It has been reported one or more times on *Picea*, *Prunus*, *Sambucus*, *Sassafras*, and *Xanthoxylon*.

Range: This fungus has been noted on oaks and on eucalyptus in Golden Gate Park. It exists practically worldwide. The decay is a delignifying rot of the general type. As a result, the interior of the trunk or of the larger branches is reduced to a soft, spongy, whitened mass.

Symptoms: The hard, woody, thick perennial conks are usually hoof-shaped, but sometimes shelf-like, and they may attain a width of 8 or more inches. The upper surface

is grayish-black to black, dull or shiny, at first smooth, but becoming rough and cracked with age. The undersurface is brown with the mouths of the tubes small and circular in outline. The context or interior of the conk is rusty-brown and shows many layers of tubes, those in the older layers being conspicuously stuffed with white. Normally, one tube layer is formed each year. The conks usually issue from knots or occasionally from wounds. On dead, down trees the conks are sometimes thick crusts. Typical punk knots may appear at branch stubs, showing rusty-brown punky substance when chopped into.

Control: No effective control is known for this fungus. Removal of infected trees is desirable.

Fomes pinicola (Red belt fungus)

The name reflects the blackish-red margin of the sporophore.

Hosts: It is common on wood of gymnosperms and has occasionally been found on angiosperms. It was found on a Monterey pine log in Golden Gate Park.

Range: *F. pinicola* has been found from New Brunswick to North Carolina, west to California and Alaska, and in Mexico and Haiti. It is distributed throughout the North Temperate Zone.

Symptoms: The sporophore is a sessile, woody, hoof- to shelf-shaped, perennial and may attain a width of 2 feet but usually varies from 2 to 10 ten inches. The upper surface is often covered with a reddish, resinous layer which may persist at the margin, becoming dry, and varying in color from grayish to black, hairless, and grooved with age. The pore surface is yellowish-white and, when fresh, darkens when bruised.

The fungus, a saprophyte, is the most common destroyer of dead coniferous timber. It can be responsible for the rapid deterioration of merchantable timber killed by windthrow, insects, fire, and other agents. It also causes heart rot in living trees. *F. pinicola* produces a reddish-brown crumbly mass with a tendency to break into cubes. Prominent mycelial felts develop in the shrinkage cracks.

Control: There is no practical control of this fungus. It can be kept to a minimum by removing all stumps and tree trunks when a tree succumbs from any cause.

Needle Diseases

Lophodermium pinastri (Pine needle cast)

This needle disease has been found on 24 pine species and some hybrids.

Hosts: In California, *L. pinastri* has been found on knobcone, digger, ponderosa, Jeffrey, lodgepole, whitebark, western white, Monterey, sugar, and Coulter pines. It has been found on Monterey pine in San Francisco.

Range: This needle cast is widely distributed. It has been found from India to Russia as well as in Denmark, Sweden, Scotland, Austria, Germany, and Italy. It ranges throughout most of Canada as well as the United States. It has been found on nine pine species in California.

Symptoms: The hysterothecia or fruiting structure is dull to shining black, amphigenous, one to several in longitudinal sections of the leaf on most hosts, sharply marked off by heavy, black stromatic lines from adjacent sections, the leaf breaking readily along these lines, elliptical and with sub-acute ends.

Infected needles on ponderosa and Jeffrey pines often remain on the tree and turn gray, giving the tree the "Old Gray Beard" appearance. The fruiting structures first appear on 3-year-old needles, and the fungus rarely if ever becomes even a weak parasite. Infected needles may remain on some trees for 10-15 years.

Appendix H. Native Vegetation Restoration Sites and Guidelines

Introduction

Eight sites suitable for expansion or restoration of native vegetation at the Presidio have been identified during preparation of the forest plan (Figure 5-1). At least six of these sites currently support native vegetation in varying amounts. The plan allocates eight sites to Emphasis Area 3 and recommends they be managed principally to enhance the native vegetative communities. These areas, in order of their recommended priority for restoration, are identified as follows:

- o Inspiration Point
- o Rob Hill Bluffs
- o Lobos Creek
- o Mountain Lake Creek
- o Public Health Service Hospital Site
- o Rob Hill
- o Horse Stable Valley
- o El Polin Creek (higher priority possible)

The first two sites are adjacent to designated vistapoints, where vistas should be improved through tree cutting according to this plan. Thus, implementation of view enhancement treatments specified for Emphasis Area 5 (Chapter 5) should be done in coordination with the recommended native vegetation restoration at these two sites.

This appendix documents environmental conditions at each site, describes vegetation now present, and presents guidelines for future restoration project plans. This appendix does not, however, provide detailed plans for restoration. Thus, prior to any restoration action at these sites, a detailed native vegetation restoration plan should be prepared. Draft plans should be circulated to the GGNRA for comment prior to finalization.

All native vegetation enhancement and restoration described herein should be carried out by personnel trained in identification of the various native species present or potentially present. The ability to recognize special-status species is particularly important. Onsite training (at the Presidio or adjoining areas) should be given and should include examination of microsite characteristics conducive to establishing each plant community and species of interest. The use of knowledgeable volunteers from the CNPS or other organizations skilled in native plant identification and habitat requirements is encouraged.

Site 1: Inspiration Point

Site Description

Location. The Inspiration Point site is located downslope to the north, east, and south of the parking area at Inspiration Point off Arguello Boulevard near the southern Presidio boundary. It extends eastward downslope to El Polin Spring. The site consists of 4.8 acres.

Environmental Conditions. Site aspect ranges from northeast through east to southeast. Slope is variable but is primarily from 25 to 30 percent. Elevation ranges from about 100 feet (above mean sea level) at El Polin Spring to 280 feet at the paved vistapoint. The site is relatively protected from wind by aspect and by the presence of a windbreak forest on the ridgetop immediately west of the vistapoint. Soils are derived from serpentine bedrock, which outcrops at the site.

Prehistorical Vegetation. The site was originally dominated by coastal prairie and serpentine grassland (Figure 2-1).

Present Vegetation. The site is presently occupied by introduced forest (including several invasive tree species), invasive shrub cover, and remnant patches of coastal prairie and serpentine grassland.

Plantings and volunteer stands of Monterey pine, eucalyptus, and coast redwood dominate most of the site. In the Monterey pine forest on the northeast-facing slopes, the dense understory contains a number of coastal prairie species (blackberry, toyon, California hedge nettle, bedstraw, soap plant, California honeysuckle, California buttercup), as well as exotics (German ivy, English ivy, plantain, cotoneaster, common chickweed, wild radish, French broom). The Monterey pine forest on the southeast-facing slope has a sparse understory of soap plant, sanicle, yarrow, common chickweed, California buttercup, California polypody, and bunch grasses. The eucalyptus forest supports an understory of French broom, German ivy, and English ivy. Little ground cover occurs in the deep shade of the coast redwood stands.

Remnant patches of coastal prairie are present on the northeast-facing slope. These contain dense mixes of bunch grasses, soap plant, yarrow, miner's lettuce, geranium, California hedge nettle, poison-oak, plantain, and common chickweed. Ice plant is invading parts of the prairie.

A serpentine outcrop on the east-facing slope supports a serpentine grassland community. Plants present include needlegrass and other bunch grasses, blue-eyed grass, California polypody, goldenback fern, California poppy, coast buckwheat, and planted Presidio manzanita.

Special-Status Plant Species. Presidio clarkia and Marin dwarf flax have been reported within the Inspiration Point area (Thomas 1986). Presidio manzanita has been planted in the serpentine outcrop.

Restoration Guidelines

Restoration Goals. The restored site should be dominated by coastal prairie. The serpentine grassland should also remain. Restoration should be coordinated with view enhancement as shown on Figure 5-2 and described in "Emphasis 5" of Chapter 5.

Restoration Methods

- o Install cable and post barriers or other fencing/gating to permanently bar vehicular use of the quarry road for other than vegetation maintenance. Bar vehicular access at the bottom of the site using post and cable fencing.
- o Map and temporarily fence or flag existing nondegraded patches of coastal prairie and serpentine grassland to prevent disturbance during restoration activities.
- o Remove all shrubs and non-native trees from existing open areas (see also Chapter 5).
- o Thin and prune Monterey pine stands to allow more vigorous growth of coastal prairie species under the tree cover and in adjacent open areas (see also Chapter 5).
- o Remove all designated eucalyptus and acacia stands (Figure 5-3). Paint full-strength herbicide on the cambium of eucalyptus and acacia stumps immediately after making smooth, level, second cuts. Manually cut eucalyptus spouts biannually until all sprouting ceases.
- o Initiate long-term weed eradication program for French broom through grubbing and herbicide application.
- o Plant coastal prairie bunch grasses in stand thinning and removal areas. Transplant sod plugs from existing grassy areas and broadcast seed and mulch mown from adjacent native stands.
- o Maintain sufficient mulch to preclude significant rill erosion. If mulch mown from adjacent stands is not sufficient to provide erosion control, use straw mulch as needed.
- o Monitor prairie establishment over the planning period, and replace unsuccessful plantings.
- o Remove patches of ice plant in the old quarry by hand or by small tractor if native scrub communities can be avoided.
- o Retain the artificial vernal pool in the quarry, but shape it to appear natural.
- o Plant native shrubs around the seismograph to minimize its visibility.

- o Provide interpretive signs at Inspiration Point and the El Polin spring loop that describe native plant communities, special-status species, and the restoration project.

Site 2: Rob Hill Bluffs

Site Description

Location. The Rob Hill Bluffs site is located between Lincoln Boulevard and Washington Boulevard south of the West Coast World War II Memorial. The site also includes an area east of Washington Boulevard. It consists of 4.4 acres.

Environmental Conditions. Site aspect is westerly, ranging from southwest to northwest. Slope ranges from 0 to 40 percent. Elevation extends from 240 to 330 feet. The portions below Washington Boulevard are on coastal bluffs exposed to the prevailing wind. The portion east of Washington Boulevard is somewhat protected by forest on all sides. Soils are variable and are derived from serpentine and other metamorphic rocks, dune sand, and other alluvium.

Prehistoric Vegetation. This site originally contained coastal scrub on the slopes and coastal scrub and prairie on top of the bluffs (Figure 2-1).

Present Vegetation. Associated with this restoration site is a small serpentine outcrop with an open serpentine scrub community located immediately south of the war memorial. The only known wild individual of Raven's manzanita occurs here. Ceanothus, iris, soap plant, California polypody, gumplant, and toyon account for most of the cover on this outcrop. Some of this community is degraded from human activity.

At the vistapoint on Washington Boulevard, naturalized or planted stands of eucalyptus block a portion of the ocean view. The slopes below the vistapoint are primarily covered by native coastal scrub, naturalized stands of Monterey pine, and large patches of introduced ice plant. The coastal scrub is dominated by coast sagebrush, mock heather, and bush lupine. Also abundant are bracken fern, coast buckwheat, poison-oak, coast chaparral broom, wild radish, and California polypody.

The roadside flat east of Washington Boulevard, which is used for disposal or storage of fill material, is dominated by grasses and weedy forbs.

Special-Status Plant Species. Several special-status plant species occur on the restoration site and the adjacent serpentine outcrop. Raven's manzanita, Presidio clarkia, San Francisco owl's clover, and San Francisco gumplant occur on the serpentine outcrop (Thomas 1986). On the slope below, Marin dwarf flax, coast rock cress, and San Francisco gumplant occur (Thomas 1986).

Seven individuals of San Francisco campion were found in 1985 on the restoration slope below the vistapoint.

Restoration Guidelines

Restoration Objectives. The serpentine scrub and other coastal scrub communities in the restoration areas should be protected, enhanced, and expanded into areas now dominated by ice plant, non-native grasses and forbs, and forest stands to be removed. Restoration should be coordinated with view enhancement as shown in Figure 5-3 and described in "Emphasis 5" of Chapter 5.

Restoration Methods

Serpentine Outcrop Enhancement and Paved-Area Restoration

- o Scrape overburden from serpentine where weedy forbs and grasses are established. Spread a new layer of topsoil over serpentine that is deep enough to provide a substrate for revegetation of serpentine species, but too thin to allow re-establishment of nonserpentine species. Plant cuttings of ceanothus, iris, and polypody into the layer of topsoil.
- o Obtain cuttings and plant San Francisco gumplant and Raven's manzanita into the layer of topsoil spread onto the exposed serpentine.
- o Construct an interpretive nature path. Include a railed boardwalk over the restored serpentine site. Explain the natural communities, rare plants, and the restoration project through interpretative signs.
- o Fence all of Washington Boulevard with cable and post. Remove paving from the paved area. Plant a diversity of trees and shrubs over most of the area.

Vistapoint Restoration

- o At the vista turnout, remove all eucalyptus and Monterey pine trees that are obstructing the ocean view as shown in Figure 5-3. Paint eucalyptus stumps with full strength herbicide immediately after making a smooth, level, second stump cut. Hand weed eucalyptus seedlings. Manually cut eucalyptus spouts biannually until all sprouting ceases.
- o Remove patches of ice plant by hand or small tractor if slopes allow and native scrub communities can be avoided.
- o Plant coast sagebrush and bush lupine in the openings, and weed ice plant, tree seedlings, and other non-native plants biannually until the native communities dominate.

Graded Area Restoration

- o Regrade the area east of Washington Boulevard, as needed, to level dumped fill and minimize slope lengths subject to rill erosion.
- o Construct post and cable fencing to exclude automobiles.
- o Plant bush lupine and coyote bush throughout the area.

Site 3: Lobos Creek

Site Description

Location. The Lobos Creek Site includes the Lobos Creek valley east of the Golden Gate U. S. Army Reserve Center. The site consists of 9.6 acres.

Environmental Conditions. The valley slopes very gently to the west, but the site extends upward on surrounding slopes facing southwest. Slopes range from nearly flat to very steep. Elevation ranges from 60 to 100 feet. Although near the ocean and west facing, the valley is somewhat protected from the prevailing wind by higher ground to the west, which forces Lobos Creek downstream of the site to flow northerly and northwesterly prior to discharging into the ocean. The substrate is primarily dune sands. These are capped by artificial fill on the easternmost slope below the old Public Health Service hospital.

Prehistoric Vegetation. Lobos Creek was originally a riparian corridor flanked by mixed evergreen forest and coastal prairie in the valley and coastal scrub on the steeper slopes (Figure 2-1).

Present Vegetation. Lobos Creek still maintains a riparian and evergreen forest corridor of willow scrub and coast live oak. A dense cover of English ivy and German ivy occurs under the oaks.

Planted Monterey pines line the south edge of Howard Road.

The upland area, north of Howard Road and east of a baseball field, contains coastal scrub dominated by coyote bush, bush lupine and mock heather. Sandy, disturbed areas contain large patches of ice plant and smaller patches of long-leaved ice plant.

Upslope from the coastal scrub is a large windbreak composed of planted Monterey cypress. The sandy slopes underneath this forest contain a sparse vegetative cover and are extensively gullied.

Special-Status Plant Species. San Francisco lessingia occurs on open sandy ground in areas dominated by the coastal scrub and ice plant.

Restoration Guidelines

Restoration Objectives. The existing riparian area, oak forest, and scrub communities should be enhanced. The oak forest should be enlarged and diversified into a mixed evergreen forest, and an extensive mosaic of coastal scrub and coastal prairie communities should be established throughout the valley. A large, sloping, forested area to the north, as well as forested areas west of Lincoln Boulevard, could also be converted to native coastal scrub communities, rather than regenerated with windbreak forests (as indicated in Figure 5-1).

Restoration Methods

- o Cut all English ivy from the trunks of coast live oaks and cut or mow all ivy on the ground. After new growth of ivy, spray with herbicide, using extreme care to prevent airborne drift toward Lobos Creek. Plant understory with wild blackberry, California rose, and coast elderberry. Consider fence removal.
- o Remove Monterey pines and eucalyptus trees adjacent to the coast live oak. Plant additional coast live oak, bay laurel, and understory species noted above to enlarge the stand as shown in Figure 5-1.
- o Erect temporary fences or flaglines around important populations of San Francisco lessingia to avoid disturbance during restoration.
- o Depending upon the need to retain the existing baseball field, plant some or all of the valley floor to coastal prairie species mixed with clumps of mixed evergreen forest species. In the short term, consider retaining isolated pines now growing on the valley floor.
- o Remove by hand ice plant growing in the coastal scrub. Plant bush lupine and coyote bush into the resulting openings.
- o Consider enlarging coastal scrub plantings to the north by selective removal of low-vigor Monterey cypress trees. Experiment with various methods to control erosion of the sandy soils while scrub communities are being established. Erosion control methods include placing cypress logs along the contour, applied mulches of mown native grasses or straw, and seeding to transitory erosion-control grasses.

Site 4: Mountain Lake Creek

Site Description

Location. The Mountain Lake Creek site is located east of Mountain Lake along a tributary drainage north of West Pacific Avenue. The site is bordered by the Presidio Golf Course to the north and east. The site is large, consisting of 13.8 acres.

Environmental Conditions. Aspect is west-southwest with a prevalence of gentle slope (about 3 percent). Slopes are steeper (10 percent) adjacent to the golf course lying on higher ground. Elevation ranges from 140-200 feet. This low-lying, inland site is well protected from the prevailing wind (high ground at the old Public Health Service hospital shields it from westerly airflow). Sandy soils derived from the Coloma Formation dominate the site, although portions of the substrate are dune sands. Both natural groundwater seepage and golf course runoff appear to supply most of the moisture to the site.

Prehistoric Vegetation. This site was probably riparian and mixed evergreen forest in its original condition (Figure 2-1).

Present Vegetation. This moist site supports a dense overstory of eucalyptus, with lower numbers of Monterey cypress and Monterey pine along the drier northern perimeter. Arroyo willow and other willows are present in parts of the creek. The ground cover in the creek and along the banks is a dense mix of English ivy, German ivy, periwinkle, and blackberry. Also found along the creek banks are poison-oak and elderberry.

A seasonal pond dominated by smartweed is present at the west end of the creek.

The northern edge of this site along the golf course contains toyon, rose, soap plant, pearly everlasting, fennel, cotoneaster, blackberry, bedstraw, and coyote bush, which form a dense understory to eucalyptus and Monterey cypress.

A fill at the east end of the site is dominated by bush lupine and deerweed. Also present are kikuyu grass, pearly everlasting, clover, and nightshade.

Special-Status Plant Species. San Francisco popcorn flower was once found near this site on a clay flat above Mountain Lake (Thomas 1986). This species is now presumed extinct (Smith and Berg 1988).

Restoration Guidelines

Restoration Objectives. Replace the eucalyptus-dominated forest with a riparian corridor flanked by a mixed evergreen forest corridor dominated by coast live oak, California bay, willow, and coast elderberry, as shown in Figure 5-1.

Restoration Methods

- o Perform restoration in a sequence of relatively small projects, using results from each area to design approaches for subsequent areas.
- o Temporarily flag or fence the seasonal pond to prevent disturbance during restoration.
- o Cut many eucalyptus in the area except for an occasional majestic individual, if desired. Lay out openings to provide full sunlight to the currently heavily shaded areas. Use eucalyptus eradication techniques described above for Sites 1 and 2, taking great care to prevent herbicide spill, over application, or application immediately preceding rainfall.
- o Maintain eucalyptus border along the north side to provide wind protection and a visual screen for the golf course.
- o Clear the swale of all English ivy, German ivy, and blackberry. Cut the English ivy and German ivy from all trees. Consider use of a brush rake. Consider applying herbicides to new ivy growth if airborne drift to wet areas can be avoided.
- o Plant the creek with willows, the banks with coast live oak and California bay, and open areas on the banks with coast elderberry.

- o Terminate all disposal of excess earth, industrial waste containers, and golf course cuttings into the swale.
- o Plant lupine on barren, recent fill and institute control of kikuyu grass.

Site 5: Public Health Service Hospital Site

Site Description

Location. This site is located east of the parking lot north of the old Public Health Service Hospital. Access is from Wedemeyer Street. The site consists of about 1.2 acres.

Environmental Conditions. This upland site slopes gently south at a gradient of about 4 percent. Elevation is 230 feet. Because of its high position and lack of windbreak to the west, it is moderately exposed to the prevailing wind. A golf course windbreak immediately to the east affords some protection. The substrate is dune sand.

Prehistoric Vegetation. This site was originally coastal scrub and strand (Figure 2-1).

Present Vegetation. The site contains scrub, grassland, and a small wetland.

This site contains a well-developed coastal scrub community on dunes. The dominant species are coast live oak, coyote bush, dwarf chaparral broom, mock heather, California coffeeberry, and bush lupine. Patches of ice plant are present within the coastal scrub.

At the east end of this site is a sandy borrow pit. Much of this area is bare, disturbed sand. The dominant plants on less disturbed sand are coast buckwheat and ice plant. The annual San Francisco lessingia is interspersed with dominant perennials.

Open grassland is also present in this site. The grassland is dominated by weedy species with some natives. Species present include bracken fern, mallow, California poppy, plantain.

A one-half-acre patch of rush-dominated wetland is present in and adjacent to a drainage ditch along the northeast edge of the parking lot.

Special-Status Plant Species. San Francisco lessingia is found in open sandy sites between perennial plants in the borrow pit.

Restoration Guidelines

Restoration Objectives. The existing coastal scrub and rush wetland communities should be protected from further disturbance and enhanced. Coastal prairie and scrub vegetation should be established in the adjacent grassland.

Restoration Methods

- o Recontour the sand borrow site to natural dune shape. Gather litter from adjacent areas and spread over the finished surface to establish a seed bank. Terminate all mining of sand from the site.
- o Hand weed ice plant from the coastal scrub. Remove pampas grass and plant bush lupine and coyote bush in the resulting openings.
- o Grade the rush wetland area to enhance wetland hydrology and rush establishment.
- o Through grading and/or import of dune sand, create 10-foot-high dunes within the existing grasslands, thus replicating the topography of the area dominated by coastal scrub. Plant coastal prairie bunch grasses, California strawberry, and Douglas iris. Plant bush lupine at the edges of the grassland.
- o Fence the enhancement and restoration site to prevent disturbance for ten years.
- o When the adjacent Monterey pines are to be removed, replace with Bishop pines.

Site 6: Rob Hill

Site Description

The Rob Hill site is a small, narrow strip between the Central Magazine and Battery McKinnon-Stotsenberg east of the summit of Rob Hill. The site consists of about 2.0 acres.

Environmental Conditions. The site is nearly flat, sloping slightly to the north. Elevation is 360 feet. The high topographic position of the site would subject it to moderately high winds, but windbreaks immediately west and north of the site afford some protection. The substrate is dune sands.

Prehistorical Vegetation. This site probably contained coastal prairie in its original condition (Figure 2-1).

Present Vegetation. The site presently contains degraded coastal prairie vegetation with a large amount of ice plant. Native plants present include dwarf chaparral broom, bush lupine, knotweed, California poppy, and yarrow.

Special-Status Plant Species. San Francisco lessingia occurs on the site in open sandy areas.

Restoration Guidelines

Restoration Objectives. The coastal prairie community should be enhanced and restored while protecting San Francisco lessingia populations.

Restoration Methods

- o Eucalyptus at the edge of the neighboring stand to the north should be cut back; see eucalyptus control methods described for Sites 1 and 2 above.
- o Perform all ice plant removal work by hand. Do not bring heavy equipment onto the site.
- o Temporarily flag or fence populations of San Francisco lessingia.
- o Within fenced areas, hand remove as much ice plant as possible without disturbing San Francisco lessingia plants. This weeding should take place during the flowering period of San Francisco lessingia (August) when the plants are most visible, and should be performed by individuals trained to recognize the plant.
- o Outside of fenced areas, pull ice plant by hand and paint herbicide on remaining ice plant pieces.
- o Plant all openings with coastal prairie bunch grasses, dwarf chaparral broom, bush lupine, and Douglas iris.

Site 7: Horse Stable Valley

Site Description

Location. The Horse Stable Valley site consists of the areas both north and south of the old Presidio stables. The site consists of about 6.8 acres.

Environmental Conditions. Both areas have northerly slope (northwest to northeast) with a typical gradient of 7-10 percent. Some slopes are as steep as 20 percent. Elevation is 40-140 feet. Since the valley slopes northward toward the bay and is flanked on the west by high ground at Fort Scott, the area is very protected from wind. Substrate is dune sand.

Prehistoric Vegetation. This site possibly supported mixed evergreen forest or coastal prairie in its original condition (Figure 2-1).

Present Vegetation. The site is mostly covered by ice plant. No native communities are present.

Ice plant provides dense cover on both of the north parcels flanking McDowell Avenue. The southeast parcel has ice plant groundcover and a Monterey pine overstory.

The southwest parcel contains ice plant covered slopes and a leveled area with considerable bare ground.

Special-Status Plant Species. No special-status plants are known to occur in this site.

Restoration Guidelines

Restoration Objectives. Mixed evergreen forest should be established on all four parcels, allowing gradual shading and eventual loss of ice plant.

Restoration Methods

- o On the two northern parcels, remove circular patches of ice plant, excavate planting holes, and plant California bay and coast live oak saplings using a "tree protection kit" for each planting. Provide water to seedlings for about three years as needed for seedling establishment; see "Revegetation Maintenance" in Chapter 6.
- o On the southeast parcel, remove all Monterey pine and plant California bay and coast live oak in its place. Treat ice plant areas as described above. Use a "tree protection kit" for each planting. Irrigate as noted above.
- o On the southwest parcel, evaluate soil conditions on the graded flat. Disc or rip the graded flat or excavate extra-large holes for tree plantings and backfill with fertilized soil as warranted. Treat ice plant areas as described above. Plant California bay and coast live oak saplings using a "tree protection kit" for each planting. Plant an understory of toyon in the same manner. Irrigate as noted above.

Site 8: El Polin Creek

Site Description

Location. This site consists of a reach of the creek flowing from El Polin Spring near McArthur Boulevard within a grassy, undeveloped area between the Main Post and personnel housing areas to the south.

Environmental Conditions. The stream flows at a moderate gradient over a northeast-facing slope at an elevation of about 40 feet. The site is well protected from the wind. The banks and streamside area are a lawn.

Prehistoric Vegetation. A native riparian community was probably present along the creek.

Special-Status Plant Species. The landscaped nature of the site precludes the possible presence of any special-status species.

Restoration Guidelines

Restoration Goals. A native riparian community, flanked by evergreen forest species, should be developed at this site.

Restoration Methods

- o Vegetation removal will be minimal at this site.
- o Based on field evaluation, develop a planting plan for establishing coast live oak, California laurel, and coast elderberry and riparian species tolerant of human disturbance.

Appendix I. Low-Vigor Stands in Each Emphasis Area

This appendix lists forest stands currently exhibiting low vigor. The listing is subdivided by management emphasis area. The last column indicates the year that stand replacement should be complete to achieve full implementation of the plan as described in Chapter 5.

Stand numbers correspond to stands shown in Figure 3-3. Areas are shown in Figure 3-3. Areas are shown in Figure 5-1. The management emphasis areas are defined in Chapter 5.

Table I-1. Low-Vigor Stands in Each Emphasis Area

Stand Number	Presidio Subarea	Percent in Emphasis Area	Species	Stand Vigor	Acreage	Number of Trees	Tree Volume (cu ft)	Volume per Acre (cu ft)	Replacement Planting Complete
1a. Windbreaks									
41	B	100	C	L	0.8	45	3209	4011	1995
44	B	100	C	L	0.2	8	365	1825	2005
46	B	20	M	L	0.6	96	16608	27680	1995
49	B	100	C	L	0.5	46	5717	11434	2000
50	B	70	C	L	1.6	184	21256	13285	1995
52	B	80	C	L	5.1	347	51214	10042	1995
62	A	100	P	L	0.4	48	2430	6075	1995
65	A	70	C	L	4.6	403	44400	9652	2005
87	A	90	C	L	4.4	2320	364147	82761	1995
91	A	100	C	L	1.8	66	8321	4623	1995
99	A	100	C	L	0.9	198	17078	18976	1995
108	A	20	C	L	0.6	18	596	993	2010
125	A	70	P	L	0.9	90	7592	8436	1995
126	A	100	C	L	1.6	240	27432	17145	1995
142	A	60	E	L	5.3	901	85966	16220	2025
149	E	70	E	L	0.4	44	4281	10703	2025
150	E	20	C	L	8.6	430	67463	7845	1995
171	G	100	P	L	0.3	30	2593	8643	1995
172	G	100	E	L	1.6	64	9125	5703	2025
173	G	100	P	L	0.9	90	7778	8642	1995
1b. Landscaped Windbreaks									
21	C	60	M	L	1.2	60	10388	8657	2000
22	C	100	C	L	2.0	320	23268	11634	2000
23	C	100	P	L	1.4	84	8151	5822	1995
34	C	70	P	L	0.3	6	360	1200	2025
57	C	100	C	L	1.2	120	1342	1118	2010
58	C	30	C	L	0.9	72	11433	12703	2010
71	D	100	C	L	1.6	80	3877	2423	1995
82	D	80	C	L	1.1	48	6631	6028	2000
150	E	40	C	L	8.6	430	67463	7845	1995
156	E	100	C	L	1.0	165	12802	12802	2005
160	E	100	C	L	0.3	84	5923	19743	2010
1c. Dune Stabilization Windbreaks									
164	G	100	P	L	2.7	756	13724	5083	2010
165	G	100	C	L	0.1	32	274	2740	2010
166	G	100	P	L	0.5	140	1986	3972	2000
167	G	100	C	L	1.4	162	9296	6640	2010

Appendix J. Allocations of Land to the Management Emphasis Areas

As noted in Chapter 5, all Presidio lands managed by the U. S. Department of the Army (as well as lands leased to the City and County of San Francisco for park purposes) have been allocated to one of the eight emphasis areas. This appendix describes the process by which these allocations were made.

The allocation process involved a sequence of allocation decisions as follows:

1. Surviving historical plantings (both entryway plantings and those windbreak plantings of high historical value) were allocated to Emphasis Area 2, "Historical Plantings."
2. Existing or planned development areas of the Presidio Master Plan, except those containing significant open space (Figure 1-2), were allocated to Emphasis Area 8, "Hazards and Landscaping."
3. Planned general open spaces of the Presidio Master Plan (Figure 1-2) that are paved or developed with play fields or lawns were allocated to Emphasis Area 8, "Hazards and Landscaping."
4. Stands west and east of Julius Kahn Park that are subject to tree-topping by adjacent residents were allocated to Emphasis Area 6, "Control Tree Topping."
5. Surviving native plant communities were allocated to Emphasis Area 3, "Native Vegetation." Some areas adjacent to these communities, usually non-forest areas supporting some native vegetation that are planned for restoration, were also allocated to this emphasis area. An area along Mountain Lake Creek currently supporting eucalyptus forest and native riparian vegetation, was also allocated to this emphasis area.

Specific management guidelines have been developed for each area allocated to native vegetation restoration.

6. Locations of existing or needed vegetation screens to block lines of sight were allocated to Emphasis Area 4, "Screens."

These areas were differentiated into three groups: areas bordering Presidio Golf Course fairways where wind protection and ball containment are also needed, portions of the original windbreak system (Figure 3-2) where wind protection and low-level visual screening are also needed, and other locations

where only low-level visual screening is needed. Some of the latter two screening types were designated to protect Presidio inhabitants from unwanted intrusions, such as busy roadways, or to enhance the visual quality of the Presidio as seen from major roadways or other public use areas.

7. Other portions of the original windbreak system (Figure 3-2) were allocated to Emphasis Area 1, "Windbreaks." These were differentiated into three groups: those on sand dunes (Figure 3-1) in the southwest portion of the Presidio, those adjacent to developed areas that serve as landscaping units, and other original windbreaks.
8. At two locations (Inspiration Point and Rob Hill) naturalized forest stands that have encroached into historically and aesthetically important vistas were allocated to Emphasis Area 5, "View Enhancement." Specific vista-restoration plans accompany these allocations. Both plans also entail restoration of low-growing native vegetation.
9. Remaining areas were allocated to Emphasis Area 7, "Diversity and Habitat." These areas currently support a variety of vegetation, including naturalized tree stands and non-native shrubs, herbs, and grasses. Since these tree stands are not part of the original windbreak system they are not considered important to maintaining the windbreak function at the Presidio. They are therefore available for the development of a variety of forage and cover conditions to enhance wildlife populations.

Once the allocations described above were made, some boundaries were adjusted to reflect special land use circumstances or to consolidate small areas that would make plan implementation too complex.

**Appendix K. Common and Scientific Names of Plants Mentioned
in the Presidio Forest Management Plan**

Common Name	Scientific Name	Native Status ^a
Arroyo willow	<i>Salix lasiolepis</i>	N
Beach strawberry	<i>Fragaria chiloensis</i>	N
Bedstraw	<i>Gallium</i> sp.	N
Blackberry	<i>Rubus</i> sp.	N
Blue-eyed grass	<i>Sisyrinchium bellum</i>	N
Bracken fern	<i>Pteridium aquilinum</i>	N
Bush lupine	<i>Lupinus arboreus</i>	N
California bay	<i>Umbellularia californica</i>	N
California buttercup	<i>Ranunculus californica</i>	N
California coffeeberry	<i>Rhamnus californicus</i>	N
California hedge nettle	<i>Stachys bullata</i>	N
California honeysuckle	<i>Lonicera hispidula</i>	N
California polypody	<i>Polypodium californicum</i>	N
California poppy	<i>Eschscholzia californica</i>	N
California rose	<i>Rosa californica</i>	N
California strawberry	<i>Fragaria californica</i> spp. <i>franciscana</i>	N
Ceanothus	<i>Ceanothus</i> sp.	N
Clover	<i>Trifolium</i> sp.	I
Coast buckwheat	<i>Eriogonum latifolium</i>	N
Coast elderberry	<i>Sambucus callicarpa</i>	N
Coast live oak	<i>Quercus agrifolia</i>	N
Coast redwood	<i>Sequoia sempervirens</i>	N*
Coast rock cress	<i>Arabis belpharophylla</i>	Ns
Coast sagebrush	<i>Artemisia californica</i>	N
Common chickweed	<i>Stellaria media</i>	I
Cotoneaster	<i>Cotoneaster</i> sp.	I
Coyote bush	<i>Baccharus pilularis</i> spp. <i>consanguinea</i>	N
Deerweed	<i>Lotus scoparius</i>	U
Douglas iris	<i>Iris douglasiana</i>	N
Dwarf chaparral broom	<i>Baccharus pilularis</i> spp. <i>pilularis</i>	N
Elderberry	<i>Sambucus</i> sp.	N
English ivy	<i>Hedera helix</i>	I
Eucalyptus	<i>Eucalyptus</i> spp.	I
Fennel	<i>Foeniculum vulgare</i>	I
French broom	<i>Cytissus monspessulanus</i>	I
Geranium	<i>Geranium</i> sp.	I
German ivy	<i>Senecio milkanioides</i>	I
Goldenback fern	<i>Pityrogramma triangularis</i>	N
Gumplant	<i>Grindelia</i> sp.	N
Ice plant	<i>Carpobrotus edule</i>	I
Iris	<i>Iris</i> sp.	N
Kikuyu grass	<i>Pennisetum clandestinum</i>	I
Knotweed	<i>Polygonum paronychia</i>	N

Appendix K. Continued

Common Name	Scientific Name	Native Status ^a
Long-leafed ice plant	<i>Carpobrotus elongatum</i>	I
Mallow	<i>Malva</i> sp.	I
Marin dwarf flax	<i>Hesperolinon congestum</i>	Ns
Miner's lettuce	<i>Montia perfoliata</i>	N
Mock heather	<i>Haplopappus ericoides</i>	N
Monterey cypress	<i>Cupressus macrocarpa</i>	N*
Monterey pine	<i>Pinus radiata</i>	N*
Nasturtium	<i>Tropaeolum majus</i>	I
Needlegrass	<i>Stipa</i> sp.	N
Nightshade	<i>Solanum</i> sp.	N
Pea	<i>Lathyrus</i> sp.	?
Pearly everlasting	<i>Anaphalis margaritacea</i>	N
Periwinkle	<i>Vinca major</i>	I
Plantain	<i>Plantago</i> sp.	I
Poison-oak	<i>Toxicodendron diversiloba</i>	N
Presidio clarkia	<i>Clarkia franciscana</i>	Ns
Presidio manzanita	<i>Arctostaphylos hookeri</i> spp. <i>ravenii</i>	Ns
Rose	<i>Rosa</i> sp.	N
Rush	<i>Juncus</i> sp.	?
San Francisco campion	<i>Silene verecunda</i> ssp. <i>verecunda</i>	Ns
San Francisco gumplant	<i>Grindelia maritima</i>	Ns
San Francisco lessingia	<i>Lessingia germanorum</i> spp. <i>germanorum</i>	Ns
San Francisco popcorn flower	<i>Plagiobothrys diffusus</i>	Ns
Sanicle	<i>Sanicula</i> sp.	N
Smartweed	<i>Polygonum</i> sp.	?
Soap plant	<i>Chlorogalum pomeridianum</i>	N
Strawberry	<i>Fragaria</i> sp.	N
Toyon	<i>Heteromeles arbutifolia</i>	N
Wild blackberry	<i>Rubus vitifolius</i>	N
Wild radish	<i>Raphanus sativa</i>	I
Willow	<i>Salix</i> spp.	N
Yarrow	<i>Achillea millifolium</i>	N

^a Native species:

N = species native to the Presidio.

I = introduced species.

N* = species native to California but not to the Presidio.

Ns = native species with federal, state, or CNPS special status.

? = native status uncertain because plant was not identified to species.